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April 1954

Agriculture

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Harrowing, St. John's, Isle of Man

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HER MAJESTY'S STATIONERY OFFICE

I.C.I. FERTILIZER AND MANAGEMENT NOTES

Early Grass

April used to be reckoned a hungry month on the farm. The grass, which began to think of growing a month ago, has had second thoughts after being licked by the east wind blowing from the frozen Baltic. Stacks are down to stumps, and pits of silage and roots are almost empty.

That is why the discovery that nitrogenous fertilizers will cause grass to grow ten days to three weeks earlier than normal has been so important.

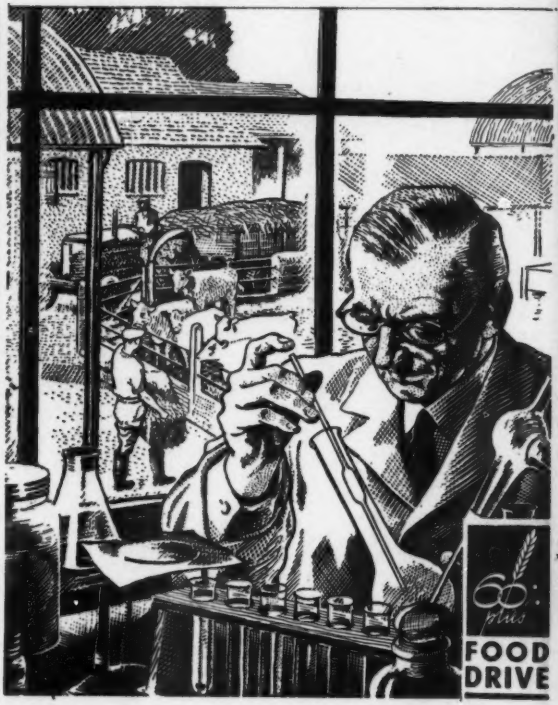
But an electric fence should be used to ration this valuable, early spring grass. The daily clean bite, the saving achieved through reducing loss by fouling, the quick fill and the longer period for rest and cudding—all these are well worth the extra trouble of moving the fence once or twice daily.

Fertilizers

There is more in the use of nitrogen than merely following the printed advice of leaflet or text book, to apply, say, 2 cwt. per acre during such and such a period—although, of course, such advice is sound and based on carefully conducted experiments.

For instance, all autumn-sown cereals should normally receive a top-dressing in May, while spring-sown cereals are given a full dressing of high-nitrogen fertilizer in the seed-bed, or top-dressed shortly after drilling.

But the good farmer is quick to give special help to a crop that runs into some trouble of soil, season, or insect attack. When a young corn seedling is "spaining"—that is, ceasing to depend upon the seed and beginning to draw upon the soil with its roots—cold winds, slugs, or a hollow seed bed can all make things difficult. A quick application of 2 cwt. per acre of 'Nitro-Chalk' can be a real "pick-me-up"—and a profit maker.



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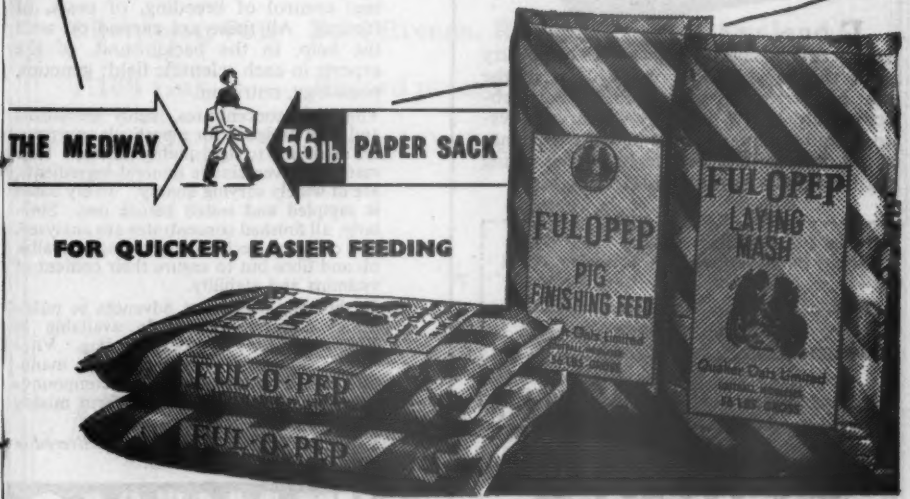

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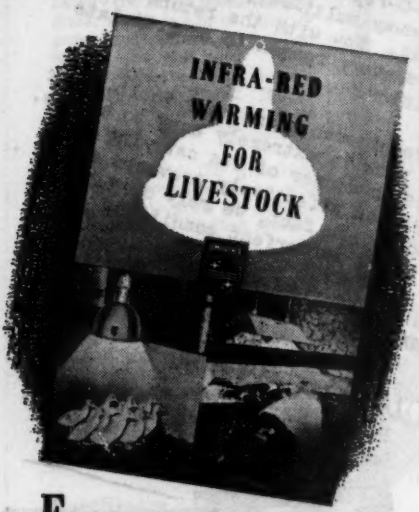

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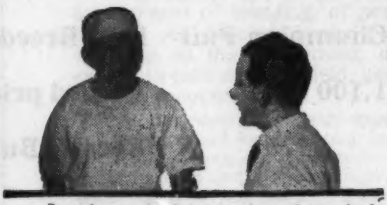

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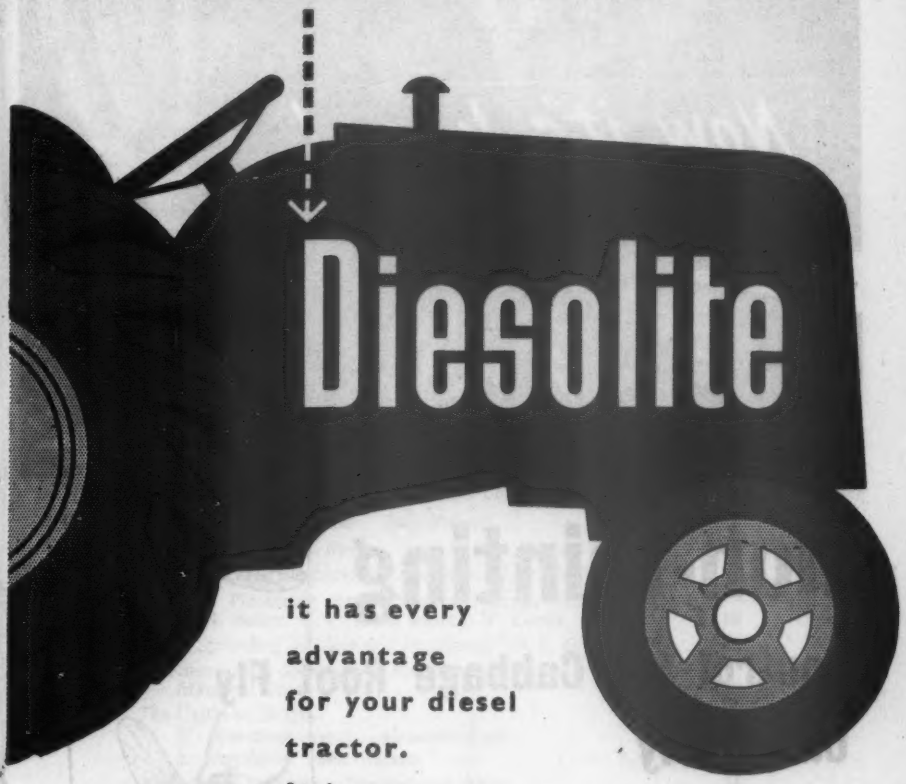

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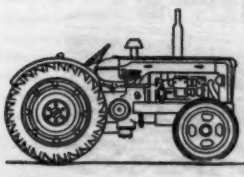

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OUR BEEF TOMORROW

PROFESSOR M. M. COOPER, B.AGR.SC. (N.Z.), B.LITT. DIP. RURAL ECON.
Wye College, Ashford, Kent

An unsatisfied home market for beef is viewed against our limited land resources.

CONSUMPTION of mutton and lamb, together, is substantially back at the pre-war level, and though there is still much to be done in the sheep industry, especially in respect of reducing the proportion of elderly and overfat mutton, our main effort must be on beef if the sirloin is to be restored to its traditional role of being the backbone of the English Sunday dinner. Beef consumption now is only about two-thirds of that before the war, and it is unlikely that it will be augmented appreciably from abroad. If there is to be any large increase in supplies, then they must be home-produced, apart of course from the very substantial increase Eire could make if she really got down to exploiting her grassland.

Our land resources are limited, and though immediately there seems to be plenty of bread corn about, there are not a lot of dollars on our side of the table, and the longer-term prospect (which we must regard if we are thinking of expanding the beef industry) is that there will have to be an increasing area in grain production. This raises questions as to where our store cattle and the wherewithal to fatten them are going to come from.

From the Hills If you read *The Times*, every now and then some enthusiast will assure you that there is beef to be had from the hills. This is true, but of necessity there will be a very limited quantity, for the sheep will always be master of the hill because of its adaptability, its capacity to produce wool as well as meat, and the rather quicker turnover of capital. The primary function of cattle on uplands is one of controlling grazing so that more productive grass species will flourish. There is a great deal of evidence on this point, not only in this country but also under similar conditions abroad. Under high rainfall conditions, where carrying capacity is measured in acres per sheep, cattle have an important complementary role, for otherwise the coarser grasses, which the sheep does not control, will dominate the finer, more nutritious grass.

This control can be achieved by agisting lowland cattle on the hill in the summer; but this is not a very positive contribution, for so much of our lowland grassland, especially in the higher rainfall areas, is also grossly understocked in the summer. Understocking, probably more than any other factor, is limiting the productivity of this grassland, since there is not that sequence of quick and complete defoliation, the return of stock fertility and

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adequate rests between grazings, which are essential if grassland is to give of its best. The alternative on the hill is running a herd of breeding cows; but this involves two serious problems—the supply of suitable stock, and supplementary feeding in the winter. So far as the former is concerned, we have a variety of breeds and crosses which are well adapted to the conditions—the Galloway, the West Highland, and some strains of Welsh Black. Crosses of these breeds with improved breeds also make admirable breeding cows. The rate of progress in hill country pasture improvement is largely geared to the fairly slow rate of increase of these hardy cows, for it is pointless embarking on more intensive hill country reclamation until there is the stock to control the additional herbage.

The other big problem with these breeding herds is the cost of wintering. So few of these farms have the necessary in-bye land; and even if they have, haymaking under high rainfall conditions is easier written about than accomplished. Silage is sometimes suggested as an alternative, but this is not a mobile source of nutriment on hill land in the middle of winter. Nevertheless, a great deal can be done by leaving foggage in more sheltered areas and supplementing it with a few pounds of hay daily as the winter deepens. Most of this hay, however, must be imported into the area.

We should be doing well if we got more than 200,000 additional stores from the hill, which is just over a million cwt. of finished beef—not a very substantial make-weight for the supplies we used to get from the Argentine. Indeed this may be an over-estimate unless we, as a community, are prepared to pay very much more for our beef. If this is the case, a national investment in the more amenable and less remote land, the millions of ploughable acres which still carry *Agrostis*-dominant permanent pastures would seem to be more attractive. It is unlikely that we shall be able to afford cattle as the primary utilizers of grass on this land. Here again, they must be integrated with sheep and the scale of operations must be large enough to spread the overheads of management and labour. This, in fact, is one of the greatest forces operating against an increase in meat production, for so many of our farms are small. An output of twenty fat cattle and perhaps a hundred fat lambs a year is insufficient to maintain a family unit, let alone any employed labour, unless meat prices are high; and yet this is the limit of many of our small farms, unless there is a tremendous intensification of grassland production. That there is technically scope for this intensification few will deny, but whether it will be economically feasible is quite another matter.

From Dairy Herds The most fruitful source of stores for fattening will unquestionably be the dairy industry. Except on the poorer land, the one-cow-one-calf system using the specialized beef breeds is too extravagant to survive, because it is so wasteful of land. Ours is the only country in Europe that attempts to maintain the luxury of such specialized beef, which is but a relic of the days of cheap food when we could afford, nationally, to ranch land. Most of the Continental beef is obtained from plough oxen or discarded dairy cows. We have no plough oxen but we have a lot of dairy cows which are bound ultimately to feature in our butchers' shops. At the same time they can be leavened by useful beef from young stock which are surplus to dairying.

On the face of things the dairy industry with its heavy weighting of specialized dairy breeds is now less well organized to supply beef stores than it was before the war, when it was largely based on dual-purpose breeds. Fortunately, the Friesian is the most important newcomer, and though its

breed society may deny hotly that it is dual-purpose, the performance of Friesian steers provides the more convincing argument. Especially is this true when stores are well reared over their first 8–9 months so that the frame and substance so essential in a beef carcass are laid down. This is the lesson of the beef-rearing trials which are in progress on the University Farm at Cambridge and at some of the Ministry's Experimental Husbandry Farms.

The use of beef bulls on dairy cows which are not required to breed replacements is another means of increasing stores suitable for rearing, and even Ayrshire crosses with the more substantial breeds like the Hereford may be worth while. Advisedly, however, a colour-marking breed should be used so that cross-bred heifers are not drafted back into dairy herds to lower production. Here we see a new role for the specialized beef breeds, which is akin to that of Down rams on cross-mountain ewes—namely, one of putting substance and quality into the slaughter generation. It gives a new objective for breeders of these cattle—one of providing sires which will do this job effectively.

Unfortunately, scope for such crossing is restricted by the small size of herds combined with a high rate of wastage. Paradoxically it almost seems, a larger output of beef depends on a much more efficient dairy industry. If the average life of dairy cows could be extended by one year, 750,000 cows could safely be mated to colour-marking bulls and we would then need fewer cows to produce the milk which the nation requires, and so release nutrients for the fattening of stores.

The demand for colour-marked calves, especially in the spring, is very strong, and prices of £15 for a sturdy white-faced calf are not uncommon. At this time of the year most calves that are worth rearing escape early slaughter, but in the autumn, when milk prices are dear, many good calves meet this fate. The high cost of whole milk for rearing is an expense which will have to be reduced. Even a hundred gallons of winter milk, worth 3s. 6d. per gallon at least, combined with about 5 cwt. of concentrates and 6–7 cwt. of hay makes a very dear weaner. Spring milk will lower the cost to some extent, but even with this the young store is going to be very expensive if the rearer is to get a fair return. There is a considerable field of investigation to be developed here, especially in the use of dried separated milk, which promises to be very much cheaper before the year is out. Dried milk which is reconstituted and has a fat substitute added can be a very sound basis for rearing calves that have had their first month on whole milk.

Beef × Dairy: An Example Within fifty yards of where I am writing there is a bunch of 2-year old Aberdeen-Angus—Dairy Shorthorn crosses, which were bought as calves and had 70-90 gallons of whole milk from nurse cows. They were rotationally grazed on clean leys during their first summer. Corn was discontinued after four months with half of them, and after eight months with the other half, when it was found that this supplement was not making an appreciable difference. During their first winter they were yarded and fed on oat straw, a little hay and silage from green pea residues. During their second summer they were mainly cleaners-up of sheep pastures, but in the process they gained 1½ lb. per day. They will mainly grade out at about 27–28 months as 10–11 cwt. quality cattle after a yard diet of hay, pea silage and a few roots, with some seconds oats over the last stages. After their first six months they have essentially been scavengers on an arable farm which already has a high concentration of sheep and dairy cows. They started as by-products of

dairying, and they have ended up as by-products of ley farming. They exemplify a great deal of our prospective beef.

It is debatable whether they should be finished in the yards. Most people will say that they should go out as 12–13 cwt. cattle off grass next summer. Unfortunately there is a pressure of other stock coming behind, there is the lure of the high grading prices in April, and we don't know what prices will be next August. It is wholly logical to grade stock off grass because grass which is grazed is the cheapest nutriment we have for livestock, provided we have a marketing and storage system which will cope with the seasonal flush. This we still lack, and it seems that in the absence of sufficient supplies from the Southern Hemisphere to dovetail completely with our production, we are likely to return to the old medieval situation of Michaelmas feasting with hard commons for the next six months. To many it may seem a sacrilege that some home-produced beef should be chilled or frozen, but the alternative is a limited supply of winter-fattened beef at prices that the ordinary family cannot afford.

It has not been the purpose of this article to discuss marketing, but when one compares the inadequate slaughterhouses and the unnecessary complications of our marketing system with the streamlined marketing of the exporting countries which reduces overheads and gets the full value out of by-products, the conclusion is inescapable that the margin between farm gate and the shopping basket is unnecessarily large. Neither the farmer nor the housewife can afford to carry it in the years that lie ahead. The sooner we have some efficient co-operatives, operating on a sufficient scale to spread overheads and to store seasonal surpluses, to set a standard for normal private enterprise to live up to, the better it will be for people at both the supplying and receiving ends. Unless we have this, the meat-producing interests in our agriculture will be at a disadvantage as compared with other interests, especially dairying. Our problem of increasing beef supplies is going to be complicated enough as it is without making it unnecessarily harder.

Some Articles of Outstanding Interest

● NEXT MONTH ●

A Labour-saving Piggery	by STEPHEN M. HAWES
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PRODUCTIVITY ON THE CHALK

JOHN ROWSELL,
Stoke Charity, near Winchester, Hants

Given fertility and good management, the chalk can be as productive as any soil in the country. Here, one of the chalkland's best known and most successful farmers explains how he has set about exploiting its possibilities.

UNLIKE some districts of the country, the chalk areas of Hampshire and its neighbouring counties could not be said today to have any recognized system of farming. Traditionally, it is, of course, a sheep and corn area, largely barley, based on a system by which for several generations the sheep were folded on roots by night and robbed the fertility from the neighbouring unfenced downlands by day. Demands for increased production and shortages of labour in the First World War, coupled with the complete financial breakdown of the system after the repeal of the Corn Production Act, made new ideas and systems inevitable. The Bayliss family and Chamberlain had already proved that with fertilizers stockless cereal production was possible, when Roland Dudley and others came along between the wars to show what mechanization and modern fertilizers could do. Hosier, at the same time, was showing how stock other than sheep could be made to maintain fertility by living off the soil which we wished to improve. He above all showed, as others were also doing with grass sheep, that by extensive rather than intensive methods the chalklands were capable of cheap production. Today, there are really several recognized methods—some of them quite intensive—of farming the chalk, but all are largely combinations of these people's ideas in varying proportions. My own are no exception.

Personally, I have always been a great believer in specialization, but I suppose that it was largely the luck of having limited capital which set me on that path. In 1936, rather than disperse my capital over several ventures, I preferred to go all out to be a stockless cereal grower, against all the advice of my critical friends. I proved to myself that that type of farming was quite feasible. In fact, it provided me with the capital for later developments. In those days I farmed just over 700 acres with four men and a rabbit-catcher, producing about 450 acres of cereals and about a further 50 acres of mustard and other seeds, and somehow managed to erect buildings, driers, etc. Being always on the job myself is, I suppose, the lesson. However, I also obtained considerable practical experience of arable cultivations and mechanization, which I believe is so vital nowadays.

The difficulty with the type of farming I was practising lay, of course, in the maintenance of fertility and the avoidance of disease. These are problems which still present themselves to people farming on similar lines today. Take-all, Eyespot and eelworm are not just bad luck; and I write this in the full knowledge of my own unpleasant experiences. I found that Chamberlain's ploughing-in of trefoil was part of the answer to the fertility problem, but I felt that the introduction of separate enterprises which would spread the rotation and build up fertility was the real answer.

Addition of Folded Stock My aim was to find something beyond my cereals which would make profits. As a start, having no water or fences, I decided that folded pigs and poultry might help in this direction. Even before the war, therefore, I had introduced the Charity

herd of Wessex Saddlebacks, with the object of not only building up fertility but, at the same time, of producing healthy breeding stock by keeping them folded on short leys. The idea of feeding anything from 3 to 5 tons of feedingstuffs per acre per year on about 50 acres of the farm seemed to me likely to do some good at least. In practice, of course, it has; for instance, when potatoes had to be grown during the war I found that bringing them behind the pigs increased the yield by between 30 and 50 per cent and allowed us to grow reasonable crops.

The same idea was behind the development of poultry on my farm, which started with folding those of a neighbour. For raising healthy breeding stock and building up fertility, I am certain that folds have been a good investment; although purely for egg production, bearing in mind the relative value of winter eggs, my experience has been that the laying battery (preferably on the cafeteria system), rather than folds, yards, or even deep litter, appears to be the most satisfactory. More recently, the introduction of a breeding project in which the number of birds per fold is considerably reduced has given encouraging results which, particularly with a return to cheaper foods, may make the fold an interesting proposition once again.

It will be remembered that in the early stages of the war the dairy cow was not looked upon with much favour by "the powers that be," whilst the capital requirements of not only the dairy cow but fencing and water were certainly beyond my resources. At that time I was in contact with Columbus Jones, who started to interest me in seed production. His ideas seemed to offer a further opportunity to introduce an additional enterprise on its own merits, while retaining the specialist cereal acreage on which I relied for my income. Seed production is obviously not the answer to the problems at large, but it is one way of making ley farming pay. I have proved that it is one way of building up fertility. Whether this is due to the humus building or the residual values of the heavy dressings of fertilizers which are vital for seed production I would not like to suggest, although I have a feeling that it is probably a combination of both. Ample fertilizers produce growth, and this in turn must build up not only top but rootage. At any rate, one has only to experience the effects of ploughed-up cocksfoot seed leys to appreciate the value of this grass from the fertility-building angle. White clovers also seem to be successful fertility builders : the heaviest crop of wheat I have ever grown followed white clover on land which I certainly should not have considered for wheat in pre-war days.

A trip to North America and Australasia some five years ago reaffirmed my views on specialization. All those who travel agree that that is the key to efficient production. But when it comes to any stock farm, this trip also made me appreciate the overwhelming necessity of proper fencing and water. Overseas visitors cannot understand why we are continually patching our fences with stakes and barbed wire. With the introduction of annual taxation relief at 10 per cent on capital expenditure for fences as well as buildings, I was, on my return, determined to see that my farm was prepared for any eventuality. I therefore instituted a four-year plan for the farm's complete enclosure with a fence which was not only proof against all classes of stock, including pigs, but which would certainly not cause me any further maintenance worries in my lifetime. One has only to look into the economics of the thing to see that fences which require no maintenance and which will virtually keep in all classes of stock must be a sound investment. The saving in the feeding of pigs by the grazing of the laid barley on the stubbles alone more than pays the interest and other charges.

The fence which I have adopted is based on a New Zealand pattern and consists of six strands of plain No. 8 wire and one of barbed wire, with intermediate posts every 20 yards, droppers every 2 yards and strainers every 120–150 yards, the whole secret of the design being the eye-bolts and ratchets, which allow considerable tension always to be maintained. Each field has now been fenced with a 30-foot driftway, for moving unpacked machinery and stock, running right through the main block of land. Pairs of 15-foot standard steel gateways allow ample movement between fields, and single gates give access to the highway and adjoining fields.

The introduction of this fencing has allowed me to develop another enterprise—the Charity flock of Clun sheep. These sheep fit in admirably with seed production, and live almost entirely as scavengers. By modifications in seed production practice I feel that it should be possible to maintain at least 300 ewes and their ewe tegs, about half of which are lambed in accordance with Clun practice as another self-contained unit on the farm. To lamb this number of sheep every year at the average production of a lamb-and-two-thirds to which we have now become used, I have considered it necessary to provide every facility for handling, and, apart from centrally-placed drafting yards on the Australian pattern, a sheep shower for the control of fly strike and a wool shed for shearing and trimming have been erected at the homestead, virtually at the centre of the farm.

Fertilizer with Every Crop I believe that on the chalk it is possible to practise almost continuous cash cropping, so long as ample fertilizers are used and the humus level of the soil maintained. Our practice for a number of years has been, therefore, to supply every crop with fertilizers. As in the past, quantity rather than quality in cereals, according to my calculations, is likely to pay the best dividends for the immediate future. I therefore try to pick strains which will respond to heavy dressings of fertilizers and stand while doing so. All cereals usually receive 2–3-cwt. of a compound fertilizer, containing 12 per cent N, 12 per cent P_2O_5, and 15 per cent K_2O, applied by a combine drill. The nitrogen level on the autumn-sown crops is sometimes reduced, but it is never left out completely, since it has been found that, owing to the cold nature of the country and the depredations caused by a large hare population, some nitrogen helps to ensure an initial plant.

The practice for a number of years has been to maintain four forms of nitrogen on the farm—sulphate of ammonia, " Nitro-Chalk", nitrate of soda and nitrate of potash. Sulphate of ammonia, being the cheapest in unit value, is used wherever possible, but on the clay caps, etc., where the lime content is on the border line, and for late applications, " Nitro-Chalk " is often used. Nitrate of soda is retained for use where quick action is necessary, and I know that I have saved doubtful looking crops with a dressing of 2, 3, 4, and up to 6 cwt. per acre. Nitrate of potash is used, when the price warrants it, on barleys and particularly on sugar beet and mangolds. Autumn-sown cereals receive, as a general rule, 4 cwt. nitrogen, usually in two dressings. Spring-sown crops, in addition to their basal dressing, receive 1–3 cwt. nitrogen, according to variety and condition of the crops.

The aim with the herbage seed crops is to feed them to give maximum yields, and fertilizer applications are regulated according to the condition of the crop and the age of the stand. Generally, applications are not made until the spring, when growth begins, although backward crops and clover usually receive some fertilizer in the autumn. Ryegrass, timothys and

fescues would therefore receive 1–2 cwt. sulphate of ammonia or a high-grade complete fertilizer in the autumn, according to circumstances, 4 cwt. of a No. 1 type of fertilizer in the spring, and 2–3 cwt. nitrogen later. Cocksfoot, being a particularly gross feeder, must make some autumn growth, and applications of 2 cwt. sulphate of ammonia or compound fertilizer, according to circumstances, may be given. In the spring, 4–6 cwt. of a compound and a similar amount of nitrate of soda or nitrate of potash are normally applied. With clovers, it is the practice to apply 1 cwt. muriate of potash and 3 cwt. superphosphate, or the equivalent in the form of a compound, in the autumn.

Ley Management and Weed Control In order to provide early bite, Italian and now H.1 ryegrasses have been introduced at one end of the farm in recent years, away from the perennial seed production areas. These are all adequately isolated by blocks of cocksfoot, meadow and creeping fescues, etc., where the changes can be rung with timothy and red and white clovers. The Italian or similar types of ryegrasses, lightly grazed in the autumn, provide ample feed by lambing time or March 1. A light subsequent grazing usually follows, then, when the paddock is shut up for seed in the first week of May, it is given 4 cwt. of sulphate of ammonia. The seed crop is usually ready early in August. S.23 and S.24 cannot be grazed in the spring if they are being retained primarily for a seed crop, but a certain area of S.23 and S.100 white clover combined can be grazed into May. This, together with the red and S.100 clover, provides all the necessary sheep grazing until at least mid-June. After that date, areas around the poultry, together with some unploughable water meadows, fill the gap, which is relieved soon after the herbage seed harvest begins.

Spraying for weed control has been a boon on the chalk. There is no doubt that the low-volume sprayer is now a necessity on this type of farm, but experience has shown here that high volume is preferable in many cases. Charlock, which was the bugbear of the chalk, can easily be controlled, even in cereals undersown with clover. Our experience has been that very small quantities of spray can be used with satisfactory results so long as the weather conditions are suitable. Docks, which had become such a menace to seed production, have, by the use of high-volume hormone spraying, almost been eliminated, and many other weeds have been brought under control. Possibly only chickweed and mayweed present real difficulties at the moment, due to a reluctance to use DNC where game is preserved. More recently, DDT miscible sprays have solved the problem of flea beetle and have been used for the control of pollen beetle in mustard, rape and clover crops.

Grain Storage and Drying Having farmed before the war and experienced the difficulties of marketing grain when there were about a hundred combines in the country, I have always appreciated the necessity of grain storage. Bins to take 200 tons were erected in 1940, and a further 200 tons of storage was added a few years later. This space has been gradually increased until now it can cope with 80 per cent of the cereal acreage. I am an advocate of self-emptying bins, having had experience of both types. Indeed, the provision of additional men for trimming bottoms and tops often presents quite a problem at the time it is required. I have found from experience that the storage of grain necessitates adequate drying,

and the plant which was installed in 1936 for a rated output of 2 tons an hour has now been replaced with one with an output of 5 tons. So long as grain has really been dried down to 13 per cent moisture content and is cooled before storage, no further worries need arise. I am certain that properly situated thermometers are also a vital piece of equipment. The slightest deterioration can easily be checked and, so long as adequate turning arrangements are available and the grain is watched and turned, it can, in an emergency, be stored temporarily up to 18 per cent moisture.

To prevent any mixing of herbage and cereal crops, sacks are labelled with numbered coloured labels as they come off the machines, and this also gives an indication of the numbers being handled.

Seed drying has always presented problems, but a continuous, oil-fired drier successfully dealt with it for a number of years. This was recently removed to make way for other buildings and was replaced by a sack drier, which up to the present has not been found large enough to cope with the enormous output of seeds which the four combines and an equal number of hired ones can suddenly create during harvest. Neighbours in the past (and I hope in the future!) have assisted, although more extensive arrangements are in hand.

Seed has been cleaned on the farm for a number of years to very high standards, and in recent years considerable efforts have been made to retain the cleanings both from the seed and cereal harvests. These, when bulked, have been found to analyse almost the equivalent of dredge, and it is expected that at least 50 tons of expensive feedingstuffs will be replaced by cleanings this year.

Standardization and Mechanization Field equipment is a subject on its own. It seems to me, however, that there are several vital factors which must be carefully considered before decisions are made. Standardization must be the aim on any farm, but when one considers that haulage and other light jobs can account for almost half of the tractor work on a farm, the provision of a tractor suitable for all classes of work is well nigh impossible. If it were possible, the labour force required would far outweigh any economies. On my own farm we have found that the horse can lead to enormous savings in this direction. As for tractors, I feel that in keeping as near as possible to the aim of standardization it is essential to have some big tractors and machines which will break the back of the heavy cultivation work. These should help to achieve the all-important requirement of timely work. Delays, particularly at springtime and harvest, can affect yield more than any other factor. The maintenance of machinery is a vital factor on any farm and, as far as possible, I should like to see the establishment of the principle of " one operator—one tractor ", and even try to see that certain machines, particularly the more complex ones, are the responsibility of an individual. In that way, not only can pride be taken but responsibility is established.

I am convinced that provision for maintenance and repair should be made on every farm, however small. No farm should be without a properly-equipped workshop with a qualified person to work in it, even if it is the farmer himself. Personally, I would prefer someone who had worked on the land and turned mechanic to the technical man with little understanding of the practical problems. In my own case, I have found that evening classes at a nearby technical college have provided all the knowledge that is required.

The equipment of the workshop, to my mind, should be more complex than many would consider necessary at first sight. Most American farms are fitted with welding plants, and from my own experience I am certain that most of ours ought to be. Those who have never had the benefits of gas and electric welding have no idea of the economies in maintenance, modification and improvization, which can be achieved. This also applies to stationary plant and buildings, as distinct from implements.

Unfortunately, electricity is still available on too few farms, but perhaps if we put as much effort into getting it there as we did to obtaining compensation for wayleaves in the past, one day we may all have it. If we use more of it when we have the opportunity, it may become cheaper than it is today, spreading overhead charges. For my part, apart from motorizing every possible manual effort, I would replace every internal combustion engine I possibly could with electricity. Apart from the fact that it is far cheaper, electric motors have a very long life, virtually never let one down and are far less exasperating. The simplicity of installing a standby alternator, tractor-operated if necessary, should allay the fears of the faintest hearted from electrifying to the hilt.

The chalk today is really not all that different from the rest of the country. It is easy to work, and fertility and management can make it comparable with the best. Perhaps the only difference is that it needs a watchful eye and experience to realize why certain things happen and when help is necessary. Only the farmer himself can do this.

Some photographs taken on Mr. Rowsell's farm are shown on pp. ii–iii of the art inset.

NATIONAL DIPLOMA IN AGRICULTURAL ENGINEERING

The final examination for the National Diploma in Agricultural Engineering will be held on July 20-23, 1954. Entry forms and the names of the colleges approved for training may be obtained from the Secretary of the Institution of British Agricultural Engineers, 24, Portland Place, London, W.1.

SOIL AND SALT

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Five to sixty tons of salt per acre was the legacy left to agricultural land on the East Coast by last year's sea flooding. Drainage, time and patience are the three chief requisites for the soil's rehabilitation.

IT is just over a year since 160,000 acres of agricultural land on the East Coast of Britain were flooded and damaged by sea water, and this therefore seems a suitable moment to review the progress that has been made in the restoration of this flooded land. In the main, work has been confined to drainage and applications of gypsum and, on quite an appreciable acreage, light surface cultivations to control weeds, but there is every justification for feeling satisfied with the situation to date.

Salt causes damage in two ways: in the first place, it is toxic to crops; secondly, it brings about the collapse of soil structure. Obviously then the first aim in restoring damaged land must be to get rid of the salt which is the cause of all the trouble. The only way it can leave the soil is in the drainage water, whether the soil is naturally or artificially drained. Ploughing merely undoes the good work of nature by bringing to the surface some of the salt that has been washed down by the rain. There is still a lot of wishful thinking among farmers impatient to start ploughing that salt will evaporate into the air. It will not! On the contrary, when the soil is dry the salt crystallizes and can be seen as a white rime deposit on and near the surface.

Sea water flooded over the land to a depth of 5 feet will bring with it 180 tons of salt per acre. When the floods recede and the surplus water has gone, as much as 20 tons of salt per acre will be left in the soil. In point of fact, the amount of salt left by the 1953 floods varied from as little as 5 tons to as much as 60 tons per acre—the actual amount depending on the depth of the water, duration of flooding, depth of penetration into the soil, nature of the drainage, and many other factors. The average for the whole area was somewhere about 18 tons per acre.

The value of drainage in getting rid of the salt has been clearly demonstrated by comparing the fall in the salt content of drained and undrained fields over the year. On the well-drained fields, the total tonnage of salt declined slowly during last summer, but the rate of fall was accelerated with the first of the autumn rains. On the undrained fields, however, the total salt content remained unchanged throughout the summer, and although the salt was washed down from the surface by the autumn rains, it accumulated as a reservoir at the lower depths, so that the total amount of salt in the land remained much the same. Each summer, other than an exceptionally wet one, it will rise to the surface, producing conditions intolerable, or even fatal, to crops. The amount of salt in the working depth of the soil will, of course, gradually decrease as it works deeper into the land, but it will be many years before crops on undrained soils are free from the danger of attacks of salt from below. On land with impeded drainage, especially where the salt content is high, the most helpful job of rehabilitation in 1954 will therefore be drainage. Where conditions are suitable, mole draining will do the job, but it must be remembered that the life of the mole is likely to be less than normal, owing to collapse and silting up resulting from the breakdown of the soil structure.

Many farms on London Clay, which are undrained except by ditches, have been flooded by sea water in the past, and they carry the scars of those inundations to this day. Every dry summer the old flood line can be plotted in the corn, and the lighter yields obtained are the penalties that have to be paid until drainage is carried out. Let there be no doubt about this point; unless the salt is removed by natural or artificial drainage, it will be there as a potential menace to crops twenty years hence.

Salt breaks down Soil Structure Now let us consider the problem of soil structure collapse and measures to combat it. When a soil is in the desirable condition for normal cultivations, the minute clay particles are held together in aggregates of various sizes. Between the aggregates are the pores through which air, water and roots enter the soil. In the formation of these aggregates the individual clay particles group themselves into small clusters or "flocs", due to the effect of the calcium adsorbed to their surfaces. Diagrammatically, we can picture a floc of clay particles as a tiny bunch of grapes bound together by their skins and stalks, the latter representing the calcium. Under the action of weathering, the clay flocs group themselves together into aggregates. Again, figuratively, we can picture an aggregate as three or four minute bunches of grapes in a paper bag, the bag representing the calcium holding the bunches together.

Salt is sodium chloride. Its effect on the soil is for the sodium part to push out some of the calcium from the clay aggregate. Whereas prior to flooding we had a calcium clay, after flooding we are left with a mixed sodium and calcium clay, or even just sodium clay. Sodium clay only forms aggregates while free salt remains in the soil. This action of the free salt in preserving the soil structure was most pronounced last summer in the beautiful tilths that could be obtained with very little effort on the flooded land. As the salt is washed down from the surface by rain, the clay aggregates of the washed soil begin to break up into loose flocs. If, in this stage, the soil is left undisturbed, one has only, so to speak, to repair the damage to the surface of the aggregate. In other words, we must put the little bunches of grapes back into paper bags. But if the soil is disturbed—for example, by ploughing—the sodium will penetrate right into the aggregate, attack the flocs and displace the calcium of the individual clay particles. When this happens, the individual clay particles tend to settle down into a structureless mass. In this state, when the soil is wet the clay particles are held apart by water films. In fact, they are so well lubricated by water that they form muddy pastes. On drying, they pack tightly together into hard, intractable, concrete-like clods. Experience in this country has shown that it takes fifteen years or more for land damaged by ploughing too soon to recover. Some of the few farmers who ploughed against advice in 1953 have already run into trouble, for every time it rains their fields are muddy pastes.

The Value of Gypsum It is very significant that so far there has been remarkably little collapse of soil structure on salt-water flooded land where light surface cultivations have been done, except for the top two or three inches or below wheel tracks made when the soil was moist. But the fields on which there has been the least deterioration of structure are those which were dressed with gypsum and otherwise not touched. The gypsum appears to have been washed into the surface evenly, in spite of summer capping and cracking. The evidence to date makes one wonder whether, under British conditions, more harm than good results

from light surface cultivations, and it must be admitted there is a growing weight of opinion among observers that it is better to leave the surface undisturbed until the fall in salt content warrants sowing a rehabilitation crop.

At the present time we are at the stage when the top few inches will have been washed free of salt on much of the land. This is a most critical point. If the land is ploughed it might produce a crop this year, provided there is sufficient rain to keep the salt from rising to root level, but it will produce nothing but intractable clods for years to come. Every farmer with flooded arable land took the first step in combating this soil structure problem when last year he applied gypsum at the rate of 2–2½ tons per acre. Gypsum is calcium sulphate, and its effect is for the calcium part to displace the sodium and re-establish a calcium clay. Lime cannot be used to supply the calcium, because under these conditions it produces sodium carbonate in the soil, and this merely adds to our troubles. So far, the gypsum has been effective only on the surface soil to a depth of between little more than an inch or two on the clay soils to perhaps three inches on the lighter soils. Even so, its action in preserving the crumb structure is so pronounced that one can tell which fields have been dressed with it and which have not, merely by walking across them when the land is moist. On the gypsum-treated fields one walks in comparative comfort; on the untreated fields one slides about on the slimy surface or, if light cultivations have been done, one picks up half the field on one's boots.

Although February was a wet month, the past winter as a whole has not been favourable for getting rid of salt. Throughout the flooded areas most of the drains were not running until February. Soil samples taken at the end of February showed most disappointing falls in the salt content, particularly on the poorly drained soils. Unless the coming summer is abnormally wet, much of the salt will rise to the surface in the warm weather, producing toxic conditions and recreating in effect conditions similar to a second flood. The amount of gypsum that has already been put on the land will not be sufficient to re-establish stability of the soil structure. Arrangements are, therefore, well in hand for the same quantity to be applied in 1954.

In this article emphasis has been laid on the total salt content in the soil in tons per acre in preference to the more familiar method of quoting the salt percentage at the various depths. This is deliberate, because the salt moves up and down the soil with the movement of the soil moisture, and consequently the salt content at any particular depth varies with the season of the year and the amount of rainfall. The vital factor, therefore, is the total amount of salt within striking range of the plant roots. For the practical man, as distinct from the scientist, this is best assessed by knowing both the concentration at the various depths and the total quantity in, say, the top 18 inches of the soil.

Fibrous-rooting Crops for Rehabilitation Where the salt content has fallen this spring sufficiently to give a reasonable chance for survival in an average summer, a crop should be sown so that root action and coverage may contribute to the process of restoration. This first cropping will rarely be commercial cropping in any sense of the word. It will be an operation of rehabilitation. Compared with 1953, the soil will be in a most unstable condition as regards structure. Cultivations should, under no circumstances, exceed three inches, and should be shallower if possible. For this reason, and also because a mass of fine fibrous roots are far more effective in opening up the soil for the even percolation of the gypsum down through it, the choice of crops will be confined to grasses and

cereals. Of the cereals, barley is the most tolerant of salt and will undoubtedly be the wisest choice on well-drained land if circumstances rule out grass. The purpose of sowing the barley is to get the beneficial effects of its fibrous roots on the soil, not the problematical yield of grain. The objection to it is that, being an annual, the farmer is faced with the problem of finding succeeding crops that can usefully be grown without the use of the plough, until the soil structure has been sufficiently stabilized to permit normal cultivations; and that will rarely be less than three years on free-draining land and five on the heavier soils.

Without a doubt the best rehabilitation crop is grass, because the land will remain undisturbed for several years. Moreover, no other crop produces such a mass of fibrous roots. Certainly on the heavier soils with impeded drainage the only sensible thing to do is to put the land down to grass for a time. This will involve a change of policy on many farms for a few years and raises problems such as water and fencing, but these are not insuperable, and in a disaster of this magnitude it is inevitable that a number of consequential problems have to be met. It is indeed fortunate that perennial ryegrass, the commonest of our useful grasses, is also the most salt tolerant, being able to stand up to 0.3 per cent of salt (equivalent to about 9 tons per acre in the top 18 inches of soil).

In preparing to sow a rehabilitation crop without the use of the plough, the first thing to remember is that the land will be later than usual in drying out in the spring. When it does dry, it will set hard very quickly. In the case of barley, therefore, it may not be possible to get this year's allocation of gypsum applied before drilling. It would be wise, however, to sow a little gypsum, either with the seed or applied as a light dressing just before drilling, and add the balance after harvest. Pre-drilling cultivations should be limited to the lightest possible surface working to ensure a seedbed. In fact, the fewer surface operations, the better it will be. A top dressing of nitrogen will be found most useful. Where it is decided to sow grass, drilling should be deferred until the end of August or beginning of September, so that during the delicate seedling stage the salt will be moving down in the soil away from the tender young roots. Spring sowing involves too great a risk of the seedling grass being killed by the salt rising to the surface in the summer. Another great advantage of early autumn sowing is that the ryegrass gets time to establish itself before it has to face the competition of the annual weeds. Where annual weeds are a trouble, they can be cut or sprayed during the summer. When the weeds are out of the way, the gypsum can be applied.

Grass seed should, of course, be drilled. One of the most successful takes in 1953 was on over 500 acres of silty clay loam which was in wheat and leys at the time of the flood and was under water for five weeks. Weed control by spraying had been a regular practice before the flood and weeds presented no problem during the summer of 1953. Salt content in July was as high as 0.84 per cent in the top three inches of soil, with a total content of approximately 20 tons per acre in the top 18 inches. Gypsum was put on in the late summer and no cultivations at all were done, the grass seed just being cut in with a disc combine drill in September on the surface left by the flood. A dressing of 1½ cwt. fertilizer per acre was given with the seed. Nothing at all was done after drilling and an excellent, even sward of young grass came up, which today is looking extremely healthy. On one very small area, which was disced before drilling, the sward is only about half as good, probably due to the disced surface drying out in the exceptionally dry autumn. A salt content of 0.84 per cent is, of course, fatal to ryegrass, but rain had

fallen in late August and early September in this instance and it was obvious that much of the salt had moved down from the immediate area of the germinating seed before drilling.

Many similar examples of grass takes on salt-affected land could be quoted up and down the coast, and it is realized that where the salt content is over 9 tons per acre the ryegrass may be badly scorched or even killed this summer. On the other hand, it will have already done valuable rehabilitation work with its fibrous roots. Furthermore, it may well be that where seed indigenous to the coastal areas has been used, it may be able to withstand a concentration of salt even higher than 0.3 per cent.

To reiterate what has been said at the beginning of this article, there are two primary objectives in the rehabilitation of sea-water flooded land. First, the salt must be got out of the soil; second, a stable soil structure must be established. The farmer who forgets about commercial cropping until he has achieved these two aims will be among the first to get his land back to the pre-flood level of production.

WIND-GENERATED ELECTRICITY FOR THE FARM

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Wind-driven generators, suitably sited, can bring the boon of electrical power to farms outside the areas of mains supplies.

THE benefit of farm mechanization as an aid to increased productivity no longer needs to be proved by argument, and the insistent demands by farmers for electricity supplies are sufficient evidence that electric light and power can play an important part in easing the work in farm buildings and farmhouse. Good progress in rural electrification has been made under difficult conditions during the post-war years by the Area Boards of the British Electricity Authority and by the North of Scotland Hydro-Electric Board in northern Scotland; and the pace of this work may be expected to increase as a result of the removal last year of capital restrictions upon it. As a mains electricity supply becomes more widespread, it should be—and doubtless will be—accepted on farms; the principal need then will be to ensure that the use made of it will be great enough for economy in electrical distribution.

Without going into details of public supply tariffs, it can be said that an electricity supply from a main network is likely to be cheaper, in the great majority of instances, than its alternative—supply from small, privately-operated generating plants. But there are many farms and small communities in the remote parts of Great Britain which lie outside areas where a mains supply can be provided economically. Further depopulation of these already thinly populated districts, undesirable though this is, becomes almost inevitable in the absence of those amenities which electricity can provide. What, then, are the possibilities for the small-scale generation of electricity? Among these are oil engines, which have been used frequently in the past for such purposes, water turbines, in the few places where an adequate source of water-power is available, and wind-power.

The power (Pw), in kilowatts, provided by the wind sweeping through an area of A square feet, is given by the formula : $Pw = 0.000005\ AV^3$, where V is the wind speed in miles per hour. Not much more than 40 per cent of this power is likely to be extracted by a small wind rotor, but it is encouraging to note that for the area swept out by a rotor of 20 feet diameter the power available in a 30 m.p.h. wind is over 42 kilowatts. The proportionality of the power to the *cube* of the wind speed emphasizes the importance of selecting a good site for a wind-power plant ; an increase in wind speed of even one or two miles an hour can have a significant effect upon the energy which will be generated over the year.

The obvious advantages of the wind for producing power are that it is a free and inexhaustible source of energy, it is clean, involves no transport or storage of fuel, no extensive area of ground is required for the installation, and no elaborate maintenance is called for. It has equally obvious disadvantages in that it cannot be depended upon for power at any particular time, and although the wind energy is free, the low density of air (as compared, for example, with water) means that a wind turbine must be relatively large, so that the plant required to capture the wind energy is by no means "free". Nevertheless, partially counterbalancing the fact that the occurrence of wind cannot be predicted with certainty far in advance, its annual quantity is remarkably constant. Especially in windy districts, the annual average wind speed seldom varies by much more than 10 per cent from the long-term average. One can thus depend on a fairly constant annual supply of energy, but most of this energy must be used as and when it is generated, since battery storage of electrical energy is expensive.

What it Costs The cost (p) (in pence per kilowatt-hour) of electrical energy from a wind-driven generator depends upon the initial cost of the installation (£P per kW.), the percentage of the annual charges for interest, depreciation and maintenance (a), and the specific output of the plant (w)–expressed in kilowatt-hours (kWh.) per year per kilowatt installed.

Obviously, then,

$$p = \frac{240Pa}{w}$$

so that the lower the initial cost (P), and the higher the specific output (w), the more economical will be the power generation.

The cost will vary with the size of the plant and its design. Thousands of small, wind-driven, direct-current generators of up to about 2 kW. capacity have been installed and used, with batteries, for electric lighting at isolated places in many parts of the world during the last two or three decades. Their present installed cost, including the battery, is usually between £150 and £200 per kilowatt. At 12½ per cent for the annual capital charges (including between 1 and 2 per cent for maintenance), the annual running cost is thus £20—25 per kilowatt. The output varies greatly with the windiness of the site but, taking it as 1,000 kWh./kW., the energy cost will be 4.8—6d. per kWh. Although this cost is too high to be generally economic for power purposes, for electric lighting it is not excessive. It probably compares favourably with the cost which would be incurred in providing a mains supply in an isolated district for lighting only ; the fixed charges on distribution equipment can only be recovered, with a low unit charge, through a much higher consumption than that required for lighting. The low output of 1,000 kWh./kW. (as compared with a theoretical maximum of 8,760 kWh./kW. if the plant were giving full output during every hour of the year) is brought about by the restricted site selection arising from the low

voltage of these small machines, which must be located very close to the premises to avoid an excessive drop in voltage. This output corresponds to a site having an annual average wind speed of 10 or 11 m.p.h., with a wind-power plant giving its full output at a wind speed of 25 m.p.h.

To supply power loads on a farm, or to provide lighting and domestic loads for a small community, a generator of greater capacity – of the order of 10 kW. – would be required. Machines of this size are being developed, and their capital cost may be of the order of £120 per kW. (without battery storage). They will generate at normal mains voltages and so may be located on the best site available, at a short distance from their load, to obtain a higher specific output than that of the small, low-voltage machines. Assuming this to be 2,400 kWh./kW., and taking annual charges at 10 per cent, the energy cost works out at just under 1½d. per kWh., which is a very attractive figure. But low cost of energy depends, first, upon finding a good site and, secondly, upon adequate planning to utilize, without battery storage, every unit of energy generated in the year.

Operational Range and Output Wind-driven machines are designed to operate over only a limited range of wind speed. They begin to give a small output at a low "cut-in" speed, producing their full output at "rated wind speed" and for all wind speeds above that value until, to avoid damage, they are shut down in wind speeds of perhaps 60 or 65 m.p.h. Let us consider three designs with operating ranges ("cut-in" to "rated") of (a) 10–20 m.p.h., (b) 13–25 m.p.h. and (c) 17–30 m.p.h., with shut-down at 60 m.p.h.

The table below gives the approximate number of operating hours in the year, the number of hours out of service, and the specific outputs, for wind-power plants of each of the three operating ranges of wind speed.

Comparison of Performances of Three Types of Wind-power Machines

	Operating Range (a)			Operating Range (b)			Operating Range (c)		
Annual Average Wind Speed	Period out of Service	Operating Period*	Specific Output	Period out of Service	Operating Period*	Specific Output	Period out of Service	Operating Period*	Specific Output
m.p.h.	*hours*	*hours*	*kWh./kW.*	*hours*	*hours*	*kWh./kW.*	*hours*	*hours*	*kWh./kW.*
10	5,000	3,760	2,100	6,000	2,760	1,300	7,400	1,360	700
12½	4,000	4,760	2,650	5,200	3,560	1,600	6,500	2,260	1,100
15	3,300	5,460	3,850	4,600	4,160	2,720	5,700	3,060	1,770
17½	2,300	6,460	4,600	3,400	5,360	3,500	4,700	4,060	2,300
20	1,500	7,260	5,350	2,400	6,360	4,200	3,400	5,360	3,100
22½	1,200	7,560	5,900	2,000	6,760	4,850	3,200	5,560	3,750
25	1,100	7,660	6,200	1,900	6,870	5,450	3,000	5,760	4,350

* Including operation at both full and reduced output

Operating range:

(a) "Cut-in" speed 10 m.p.h.; "Rated" speed 20 m.p.h.
(b) " " 13 m.p.h.; " " 25 m.p.h.
(c) " " 17 m.p.h.; " " 30 m.p.h.

In comparing the figures for the different operating ranges, it must be borne in mind that a machine operating over range (a) might have a capital cost per kilowatt up to three times greater than that of one operating over range (c). The increases in specific output and in the period of operation which result from the adoption of operating range (a) may be worth while when the average annual wind speed exceeds about 15 m.p.h. Although perhaps as much as half of the period out of service may be during the night hours, the figures for the less windy places emphasize the need for some form of storage if continuity of energy supply is to be assured.

If wind-driven generators are to be operated economically for power supply on farms, careful thought must be given to the schedule of loading to be adopted. The main object must be to make the maximum use of the available energy in supplying loads which have inherent storage and which can accept the wind-generated energy at random times. They may store the energy mechanically or thermally instead of in the electrical form. Examples of such loads are water-pumping or grinding, both of which can accept mechanical energy as it happens to become available, and thermal-storage methods of space heating and cooking, water heating, soil warming, steam raising and refrigeration, which do not require very definite timing requirements. Except in so far as equipment with inherent storage may cost rather more than non-storage types for the same purposes, these loads can be supplied at the low cost, for the wind-generated energy, of about 1½d. per kWh., as already mentioned.

If, however, some 10 per cent of the energy is to be stored in electrical form by a battery for lighting and other small-power domestic purposes, the battery needed to give up to three days' storage may cost between one-quarter and one-third as much as the wind-power plant itself. Since capital charges for the battery may be 20 per cent, owing to its rather short life, the energy supplied through it may cost about 9d. per kWh.

Research Continues The Electrical Research Association, with support from the Ministry of Agriculture and Fisheries, is investigating the possibilities for wind-power on farms and in isolated areas. Following studies of the wind regimes in different parts of the country, and of wind behaviour affecting the design of wind-driven plant, the present research programmes include one for testing several machines of different types and capacities up to 10 kW., all operating in the same conditions. One of these is of a new type having an air turbine coupled to an electrical generator just above ground level at the base of the tubular support of the wind rotor. The rotor blades are hollow and, when driven by the wind, they throw out air centrifugally at their tips and draw up air through the air turbine, which drives the generator. Another machine, from Germany, has an alternating-current generator for use in high winds, and a smaller, direct-current generator, which acts as exciter for the a.c. generator and also charges batteries to give a small amount of storage for lighting.

Another equally important research programme is concerned with the development of loading schedules making the fullest possible use of loads with inherent storage. Here the aim is to investigate all feasible methods of storage which might prove economic and to devise schemes of automatic, or semi-automatic, control to distribute the energy between the various loads to the best advantage, ensuring that every unit of wind-generated energy is utilized.

To conclude, recent developments in the construction of wind-driven generators of a capacity suitable for farm use give promise of economic exploitation. But every unit of the energy captured from the wind must be utilized, and utilized as far as possible without resorting to storage in electrical form.

Readers will be interested to know that the Ministry's Fixed Equipment of the Farm leaflet (No. 20), *Electricity for Farm and Estate*, will shortly be available. This is addressed to farmers and landowners who have access to mains electricity, but it also contains information of interest to those who generate their own supply—*Editor*

FERTILIZER PLACEMENT EXPERIMENTS ON GREEN PEAS

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The results of trials on green peas, carried out over five years, show that on soils where fertilizers increase yields the greatest responses were obtained by placing the fertilizer at the side and slightly below the seed. On average, the extra cash return from placement for picked peas was about £11 per acre.

FIELD experiments on threshed peas to compare the effect on yields of broadcasting and placing fertilizer beside the seed were carried out from 1947 to 1950 by the Chemistry Department at Rothamsted, and were continued and extended between 1950 and 1952 by the National Agricultural Advisory Service in the Eastern Province. A summary by Cooke and Dadd of both series of experiments, published in this JOURNAL last year (1), showed that there were substantial improvements in yield from drilling small quantities of phosphate-potash fertilizers in one band 2 inches to the side of the seed and 3 inches deep, as compared with broadcasting the same dressings. Concurrently with these trials on threshed peas, a smaller number of field experiments on green peas were also carried out. The work was initiated by the Agricultural Research Council's Technical Conference on Fertilizer Placement, and the special drills built by the National Institute of Agricultural Engineering, and described by Cooke and Dadd in their article, were used again.

There are two ways of harvesting green pea trials. If the peas are grown for market, the full pods can be picked and weighed ("peas plus pods"), but if the crop is harvested by a viner, only yields of peas after shelling can be obtained. In the N.A.A.S. experiments described later, the first method was used in 1952 but the second had to be adopted the following year. Unfortunately, it is impossible to compare the results of these two sets of experiments accurately, since any treatment which affects the maturity of the crop also alters the ratio of the weights of shelled peas to total produce.

FERTILIZER PLACEMENT EXPERIMENTS ON GREEN PEAS

One of the difficulties of experimenting with green peas, or indeed, with any crop harvested immature, is to decide when to begin harvesting. In these trials no special steps were taken to harvest at any specified stage of crop development, or to study the effects of fertilizer treatment upon quality by tenderometer readings or other methods.

Rothamsted Experiments The earlier experiments were situated on heavy land in Essex and Bedfordshire, since it was impossible to find sites on light, pea-growing soils where fertilizers were likely to increase yields. They covered the three years 1949–51. Granular mixtures of superphosphate and muriate of potash, like National Compound No. 7 (14 per cent P_2O_5 and 14 per cent K_2O), were used, and comparisons were made between yields obtained from similar amounts of fertilizer broadcast and placed in a side-band. The experiments have been described in detail by Cooke and Widdowson [2], and the results are summarized in Table 1. Broadcast fertilizer was applied in one of two ways. It was either spread on the plough furrows and worked in during seedbed preparation (early), or it was lightly harrowed into the prepared seedbed (late). At two sites where ploughing was very late, the early dressing was ploughed in.

Table 1

Yields of Green Peas (as picked) given by Broadcast and Placed Fertilizer, and the gains from Broadcasting and from Placement, averaging all Rothamsted Experiments in each Year (cwt. per acre)

Year	Yield without Fertilizer	Amount of Fertilizer	Yield with Fertilizer			Increase in Yield		Extra Yield from Placement over Early Broadcasting
			Broadcast		Placed in Side Band	from Broadcasting		
			Early	Late		Early	Late	
1949								
1 Experiment	76.6	3.5	82.0	84.2	95.2	5.4	7.6	13.2
		7.0	79.5	82.9		2.9	6.3	28.5
1950								
3 Experiments	83.8	2.3	81.9	84.3	97.3	–1.9	0.5	15.4
		4.6	89.7	84.3	98.7	5.9	0.5	9.0
1951								
3 Experiments	58.5	2.6	62.5	59.3	61.8	4.0	0.8	–0.7
		5.3	72.0	55.3	67.2	13.5	–3.2	–4.8

In 1949 and 1950, broadcast fertilizer applied in either way gave small increases in yield; placement gave much higher yields than broadcasting. In 1951, where the land was ploughed in late April at two centres, forcing a tilth on heavy land naturally produced very loose, dry seedbeds, and both late broadcasting and placing proved ineffective. The only worthwhile response was given by ploughed-in fertilizer. There is no evidence on normal seedbeds that there are any advantages to be gained with green peas from a deep

application of fertilizer, but in seasons when the surface soil becomes extremely dry, superficial application (including shallow placement) may not be effective.

Over the three seasons of the Rothamsted experiments, the average gain from placing, as compared with broadcasting the same quantity of fertilizer, was 9.3 cwt. per acre of "peas plus pods."

N.A.A.S. Experiments It was considered that the conclusions from the Rothamsted experiments should be verified in more distant areas, and accordingly trials were carried out by the N.A.A.S. in North Norfolk, East Suffolk and Essex, mostly on light land in pea-growing districts. No experiments were carried out on the fertile soils of the Holland Division of Lincolnshire, or in the Isle of Ely, since no sites could be obtained where the crops were likely to respond to fertilizer; moreover, peas grown in the Fens do not normally receive fertilizers.

The fertilizer used in the trials was similar to National Compound No. 10 (10 per cent P_2O_5 and 20 per cent K_2O). Broadcast dressings were applied to the seedbed in 1952, but in 1953 they were applied over the plough furrows. Two rates of broadcasting (2.5 and 5 cwt. per acre) were used for comparison with 2.5 cwt. per acre placed in one band 2 inches to the side of the seed and about 3 inches deep. As mentioned earlier, the yields of picked peas (peas plus pods) were recorded in 1952, but in 1953 a viner was used and yields of shelled peas only were obtained. The average results of all the experiments in each year are summarized in Table 2.

Table 2

Yields of Green Peas given by Broadcast and Placed Fertilizer, and the Gains from Broadcasting and Placement, averaging all N.A.A.S. Experiments in each Year (cwt. per cwt.)

	Yield without Fertilizer	Amount of Fertilizer	Yield with Fertilizer		Gain in Yield from	
			Broadcast	Placed	Low-rate Broadcasting	Placing over Broadcasting at Low Rate
1952						
4 Experiments	51.6	2.6	49.7	56.4	–1.9	6.7
"peas plus pods"*		5.2	52.3	—	—	—
1953						
2 Experiments	20.6	2.5	22.4	23.3	1.8	0.9
shelled peas*		5.0	24.3	—	—	—

* Yields of "peas plus pods" are usually approximately three times the yields of shelled peas.

In 1952, broadcast dressings applied to the seedbed had no effect, but placed fertilizer gave substantial increases in yield at two of the four centres. On average, placement gave 6.7 cwt. more "peas plus pods" than broadcasting the same quantity of fertilizer. In 1953, both broadcast and placed fertilizer gave only small increases in yields of shelled peas, and the gain from placing over broadcasting was very small.

Benefits from Placement The results of these experiments were not wholly consistent; nevertheless, at most centres there have been good gains from placed fertilizer, and for all experiments carried out from 1949 to 1952 (where the yields recorded were of "peas plus pods") the average gain from placement was about 8 cwt. per acre. Assuming that picked peas are sold at 10s. per 40 lb. bag, this means a gain from placement of about £11 per acre. The Rothamsted results (Table 1) show that placement of heavier dressings was even more profitable.

On upland mineral soils, green peas should receive fertilizer applied by a side-band placement drill. In none of these series of experiments has side-band placement given lower yields than broadcasting on the seedbed—the common practice on most farms.

There is an urgent need for commercial placement drills designed and built for green peas. Peas are not normally sown on land with an " unkind " tilth, so that the construction or adaptation of drills for side-band placement on these soils should not be as difficult as designing drills for crops sown on rougher seedbeds.

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1. Fertilizer Placement Experiments on Threshed Peas. G. W. Cooke and C. V. Dadd. *Agriculture*, 1953, **60**, 34–8.
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AERIAL SPREADING OF LIME AND FERTILIZERS

G. L. Gray, B.Agr.

Ministry of Agriculture and Fisheries

Lime and phosphates are essential to the improvement of most of Britain's hill pastures. How far can the aeroplane be used effectively and economically for their distribution ?

THE earliest forms of agriculture were practised in areas of rich alluvial soils, and it was only as primitive populations increased and the demands for food became greater, that man began to use the more difficult and less accessible areas to produce the food necessary for his survival. Today in Britain, faced with the problem of feeding our people against a background of growing world population and higher standards of human feeding, we are looking to the hills as a possible means of increasing our agricultural output. Hill lands are essentially areas of rough grazing suited to the production of mutton and wool and, in certain parts of the country, to the production of store cattle. One of the major factors in the management or improvement of any grazing area is the application, in suitable amounts and at appropriate times, of lime and phosphate. Liming has been a feature of British agriculture for a very long time, and the process of spreading has been mechanized successfully within the last ten or fifteen years. On the other hand, the use of fertilizers is only about a hundred years old. Nevertheless, the methods of distributing these plant nutrients are firmly established.

AERIAL SPREADING OF LIME AND FERTILIZERS

The self-propelled lime-spreading vehicle is by now a common sight throughout the whole of England and Wales, and a manure distributor is today a recognized part of the equipment of most farms. These machines will operate successfully on the normal slopes found in arable areas but they cannot readily be adapted to work on the more difficult hill terrain. Another major problem of applying lime and fertilizers to these hill pastures is the matter of access. In many cases it is impossible to take a lorry to the selected area, owing to the slope of the land or the absence of any kind of road. Consequently, air freight seems at first sight to be an attractive solution to the problem of getting the material on to the land.

Exploring the Possibilities A considerable amount of work has been undertaken by aircraft operators in this and other countries to discover the best means of using aircraft to dust and spray crops. Aerial spreading techniques have had considerable success in the U.S.A., and in the tropics, too, large-scale invasions of pests have been controlled. The amount of dust or liquid applied to the crops is a matter of a few pounds to the acre. Applications need to be a good deal heavier for fertilizers, and much more so for lime.

New Zealand led the field in the bulk distribution of fertilizers from the air, and this arose largely from the necessity to maintain the productivity of the hill areas. The needs were clearly to improve the herbage composition of these hill pastures and to combat soil erosion. Accordingly, in 1947 the New Zealand Air Force made available a Grumman Avenger plane with a carrying capacity of about 1 ton, suitably modified to carry a bulk hopper. The hopper was so designed that the outlet could be adjusted, and experiments proved that granules of about $\frac{1}{8}$ inch in size were ideal for this method of spreading. Flying at an altitude of 400 feet at a speed of around 125 miles per hour, 1 ton of granular fertilizer could be spread on about 8 acres. By a system of ground control, it was possible to direct the pilot so that swaths could be laid side by side over the area. Based on a standard cost of £15 per hour flying time, at an average of $2\frac{1}{2}$ sorties per hour, the cost of spreading amounted to 15s. per acre. Further work showed that the costs of top dressing from light aircraft were lower than those of hand spreading, and contract rates for this type of flying were assessed on the basis of 2 cwt. superphosphate per acre at a cost of between 7s. 6d. and 10s. per cwt. During the 1952–53 season, contractors in New Zealand spread from the air about one-fifth of all the phosphate fertilizers used in agriculture. Although a light aircraft is entirely suitable for spreading at low rates per acre, this machine is less useful when the rate of application is more than 1 cwt. Local practice in New Zealand indicates that little advantage is to be gained on hill areas by dressing the pasture with lime, and consequently the use of aircraft for spreading lime is almost unknown there.

In Britain, the Scottish Hill Farm Research Committee started in the early post-war years a series of experiments on methods of using aircraft as a means of spreading lime and fertilizers on hill pastures. Hill land in this country is almost wholly acid, and in any scheme of improving these upland grazings emphasis must be placed upon the basic need to compensate lime deficiency. It may well be that applications of more than 5 tons per acre of calcium oxide would theoretically be necessary, but such dressings would not be economic. It has been suggested that applications at the rate of 15–40 cwt. ground limestone (8–20 cwt. CaO) and 3–4 cwt. phosphatic fertilizer per acre would be about the economic limit.

Suitable Aircraft Even at the lowest rate of dressing suggested, the loads involved in aerial liming would require the use of large aircraft, and consequently trials were carried out on behalf of the Committee by the Royal Aircraft Establishment, Farnborough, to discover a practical solution of the technical problems of transporting and depositing heavy loads. At the time the only available types of aircraft capable of transporting loads of this order were Lincoln and Lancaster bombers, and these machines were adapted to carry canvas slings, underslung in the bomb bays and capable of release by the bomb-release mechanism. A 5-ton load packed in 14 and 28 lb. paper bags could be transported and dropped at the required density on the ground. The distribution was satisfactory and the method technically adequate, but machines of this kind involve high operational costs, besides runways for taking-off and landing. It was concluded that the use of the Lincoln or Lancaster bomber could not become an economic agricultural proposition.

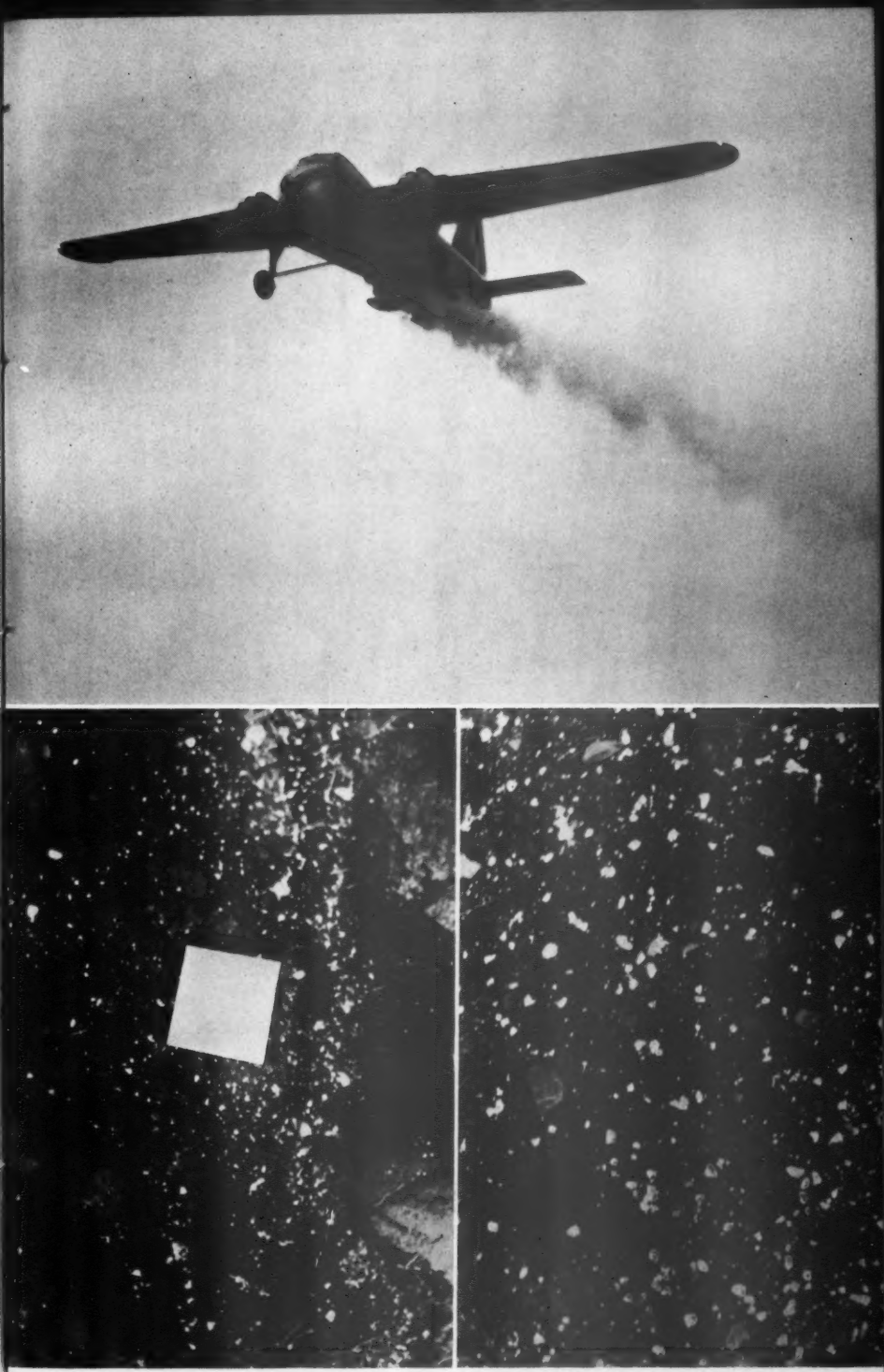
Later, the Bristol Aircraft Company undertook field demonstrations and trials in North Wales, using an adapted form of the Bristol 170 freighter. This machine can carry 6 tons. Lime, pelleted superphosphate and "Nitro-Chalk" were spread. Again the trials were successful, inasmuch as they showed that this type of aircraft, controlled from the ground, could spread determined quantities of fertilizers and lime on pastures in hilly country. The lime used was a specially prepared form of burnt lime with a particle size of $\frac{1}{8}$ inch, not normally available commercially. Aircraft of this carrying capacity require a runway for take-off and landing, and it is highly desirable that the take-off point should be as close as possible to the dropping zone.

For this type of machine the Bristol Aircraft Company has said that the costs might work out at between £40–45 per hour of flying time. On this basis, the cost of aerial distribution of phosphate at the rate of 2 cwt. per acre would amount to 7s. 6d. per acre, or £3 15s. per ton of fertilizer. An operating radius of between 30 and 40 miles from the airfield would appear to be the practical limit.

Little information is available on the actual costs of spreading lime, and long flights for the tests were undertaken in North Wales. With more frequent sorties for the much heavier dressings of lime, the operating radius might have to be further restricted.

The helicopter has proved its worth not only in trials and demonstrations but also under actual working conditions in the application of dusts, insecticides, foliar nutrients and selective weed-killers, but in so far as this machine might be used for the spreading of lime and fertilizers, although it has the advantage that it does not require a runway and can operate from the nearest point to the hill accessible by the ordinary land transport vehicle, it is limited in its scope by reason of its low carrying capacity. Machines are now beginning to come off the production line with greatly increased carrying capacity, and at this stage the helicopter should not be ignored as a possibility.

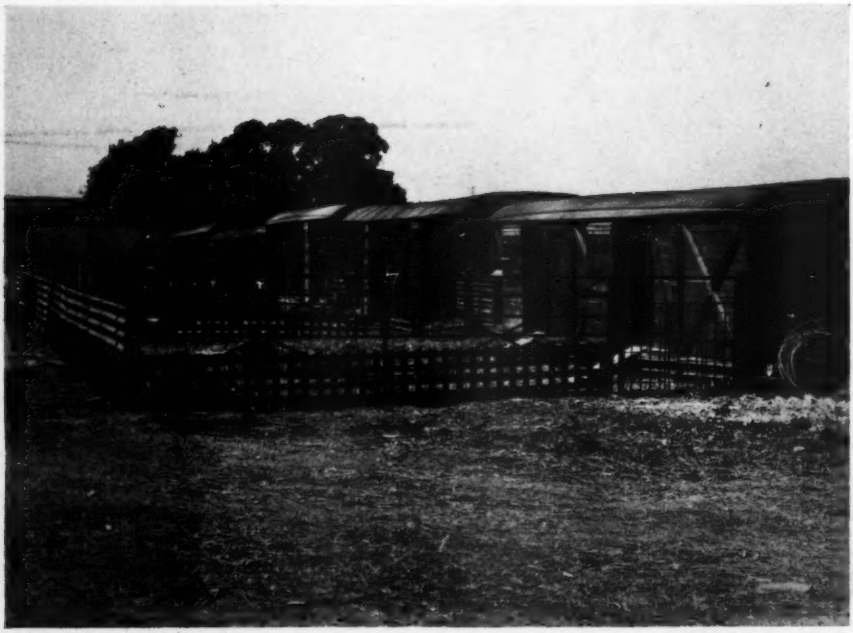
Dressings : How Much and in What Form? The problem of improved productivity from hill areas in Britain is not only a matter of improving the lime and phosphate status; as has been suggested earlier, it involves many other things, such as drainage, access, fences, etc. Indeed, as far as lime itself is concerned, little precise information is available as to the most economic quantities to apply, though the general



Photos: *Bristol Aeroplane Co. Ltd./C. Ev*

The loads involved in aerial liming require the use of large aircraft, as this Bristol 170 Freighter. The spread at the extremity (left) and centre (right) of the swath is shown with a white card (3 in. × 3¼ in.) for comparison.

A section of fencing showing the strainers (made from old railway lines) and the wire tightening arrangements.



Photos: *Farmers Weekly*

Disused railway wagons make useful pig sties.

E CHALK (See pp. 5–10)

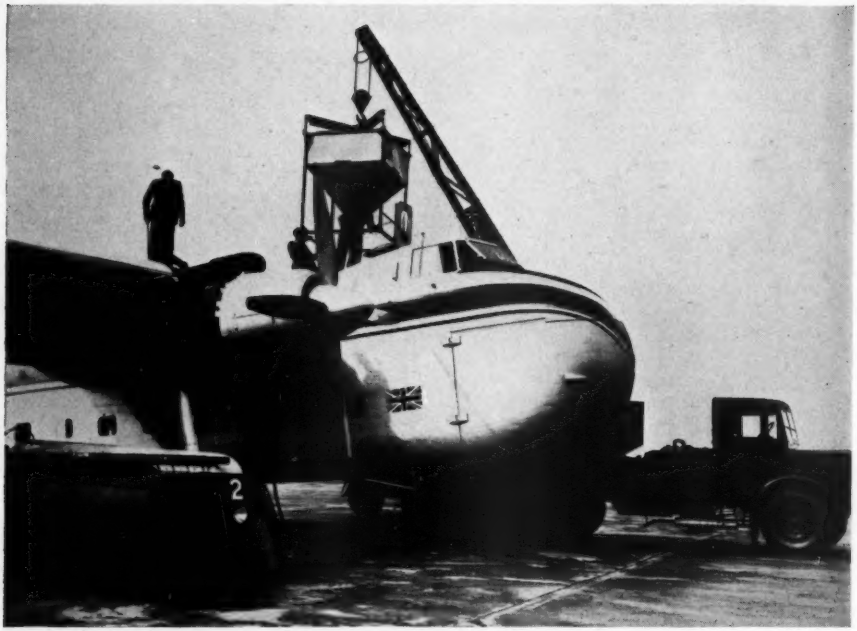
I.C.I.

Sheep fit in well with seed production. Here they are grazing an S.23/S.100 ley.

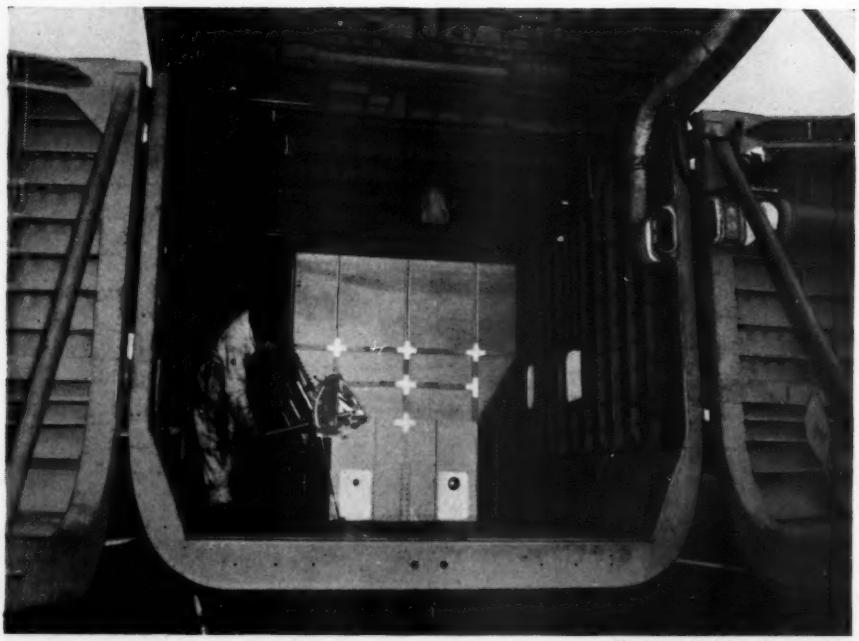
WIND-GENERATED ELECTRICITY (See pp. 15–9)

E. W. Golding

A good wind-power site at Slieve Gullion, N. Ireland



Bristol Freighter being loaded with lime.



Photos: *Bristol Aeroplane Co. Ltd.*

The aircraft was adapted to carry three 2-ton hoppers.

level of lime requirement, as estimated in the laboratory, is high. Similarly with phosphates, it is not known whether small dressings will give marked responses and trials to determine whether such small dressings as could economically be applied by aircraft would give a worthwhile response or any response at all are now being undertaken, but the results will probably not be available for some considerable time.

Since, in connection with lime, the transport and spreading costs are likely to be high, the most concentrated form of calcium should be used. This suggests that for even distribution a calcium oxide in the form of a clean screened product, roughly of $\frac{1}{8}$ inch diameter, is highly desirable. Although there are no major technical problems involved in the manufacture of such a type of burnt lime, the costs are likely to be relatively high, because of the proportion of fine material which arises in the manufacture of any ground and screened product and has to be rejected. This high cost would be partly offset by the sale of the fines as a form of ground burnt lime.

The phosphate must be pelleted, and all the trials suggest that a pellet slightly bigger than a pea is ideal. This is necessary because, with the normal types of superphosphate, a high proportion may be lost between the discharge from the aircraft and the ground.

Experience may well show that the ideal method of applying lime and phosphate to hill pastures may lie in some form of basic slag, but whether the fertilizing ingredients in basic slag would become available to the plants of these areas sufficiently quickly if the material were applied in the form of a coarse dust is not yet known.

The net effect of improving hill pastures will be to increase the quality and the palatability of the herbage which will be available for stock only during the normal growing season. The season may perhaps be extended a little by the application of fertilizers but, by and large, alternative feeding grounds or cattle yards may be necessary to finish the stock after they have been ranched on the hills during the summer season.

Limited Possibilities It would seem that aircraft might usefully be used to apply trace elements as dusts or in solution where problems of this kind arise on any hill land. On flat, arable fields it may be cheaper to mix the micro-nutrients with the usual fertilizers and to spread the mixture in the normal manner. The newer technique of fertilizer placement may, however, revolutionize the methods of spreading fertilizers on land or in conditions where this method is practicable.

Aircraft, then, can spread lime and fertilizers, but it is almost impossible to get accurately uniform distribution. Hence the technique can be applied successfully only to broad areas such as hills, rather than to the more intensively cultivated arable districts.

There is little precise knowledge of the costs or the ultimate effects of dressing hill lands in Great Britain with lime and fertilizers, but it should be borne in mind that improved fertility is only one factor leading to improved productivity in hill areas. It is unlikely that an individual hill farmer would be prepared to undertake a scheme of aerial spreading on his own, even if contract services were readily available (as in New Zealand), but the improvements noted in the areas fertilized in N. Wales suggest that if the costs of aerial spreading could be met, the stock-carrying capacity of the hills could be increased.

AGRICULTURAL CO-OPERATION IN ENGLAND AND WALES

MARGARET DIGBY, O.B.E.

Over two-thirds of the farmers in this country, it is stated, are members of agricultural co-operatives, carrying over £9 million of capital investment.

AGRICULTURAL co-operation in Great Britain has been what headmasters call "a late developer". This is not really surprising. The economic function of co-operation is to carry on the business side of farming on a scale which will ensure efficiency and competitive power, while retaining control and profits in the hands of farmers themselves. It was naturally the countries of small peasant farms, and those which sold to distant markets through unknown intermediaries, which first discovered the merits of combination. Their very success probably told against an early development of agricultural co-operation in England. An all too successful model seemed to invite direct imitation, and a type of co-operation based on the small farm and the export market needed a good deal of adaptation, usually by trial and error, before it really fitted the conditions of this country.

Half a century ago, when British agriculture was based on high farming and low labour costs, large holdings, a stable partnership between landlord and tenant, and a rapidly growing and easily accessible urban market to which produce was sold much as it left the farm, the need for co-operation between farmers was apparent only to the far-sighted. Today, and for a number of years past, the position has been greatly altered. Smallholdings have multiplied; the number of owner-occupiers has increased; landlords have ceased in many cases to play an active part; as a result partly of rising labour costs, partly of scientific research, the machinery and raw materials needed to carry on the farm have become vastly more complex and costly. The demands of hygiene, of a more critical public taste and the competition of overseas products (most of them co-operatively exported) have called for much more elaborate processing and marketing.

It is natural, therefore, to find that, in spite of the existence of marketing boards dealing with certain commodities (notably milk), there has been a great expansion in voluntary co-operation on a strictly business basis. The figures for England and Wales in 1938 and 1951 tell their own story:

	Membership	Business (£)
1938	116,150	15,114,051
1951	212,525	82,622,762

The number of farmers holding shares in agricultural co-operative societies has thus nearly doubled, and their business (partly, of course, as a result of rising prices) has multiplied 4½ times. Moreover, while in the earlier years at least three-quarters of the business done was in the supply of agricultural requirements and only one-quarter in the marketing of farm produce, the two types of business are now of about equal value. There are other points of interest. Membership now includes something over two-thirds of the farmers of the country, and though some farmers may be members of more than one co-operative, it is well known that many non-member farmers are regular co-operative customers. The increase of farmers' capital (shares and reserves) invested in co-operatives is also significant, since it has risen from under £2½ million in 1938 to over £9 million in 1951.

This remarkable expansion has not come about through the formation of new co-operatives in large numbers. There have been a few new foundations, some of them (especially in egg marketing) quickly successful: but by far the greater part of the development of the last dozen years has been made through societies established in the first quarter of the century—societies which survived the struggles of the depression years and had the necessary experience, flexibility and confidence of their members to enable them to expand and diversify their activities. These societies are today so well distributed throughout the country that there can be few farmers who cannot at least purchase co-operatively if they so desire.

Character of British Co-operatives The classic conception of the farmers' co-operative, perfected in countries like Denmark, is of an organization based on a single village and carrying out a single economic function. This was never really suited to Great Britain and has become less suited with the passage of years. In the first place, the single village co-operative was based on horse transport and the distance which a farmer could, by such means, conveniently bring his milk to a dairy or carry home his supplies of seed and fertilizers. Many British co-operatives were founded in the declining days of horse transport; they were set too near together and in some cases have hindered each other's growth. Hence the elimination of a fairly large number by amalgamation, and the survival of others which have worthy records but are now too small to offer the services which a farmer expects of his co-operative. The trend, however, is steadily in the direction of the large society covering at least the area of a county.

The idea of the *single purpose* society is in a rather different category. The fact that Danish societies are unregistered, un-incorporated groups, makes it perhaps easier to form them, and at the same time more essential to keep their operations simple. There are obvious advantages in an organization whose members are all equally interested in a single activity, and there are, in fact, a number of single purpose societies in Great Britain, especially in the marketing field, handling wool or eggs, herbage seeds or bacon. Their number may well increase.

The typical British agricultural co-operative, however, is the *general purposes* society. The nucleus, in nearly every case, is an organization for the supply of agricultural requirements, which may have been in existence for anything up to eighty years. To this has been gradually added a wide range of activities and services, coupled with a geographical extension, by means of branches, depots and transport for delivery and collection. Much, but not all, of this is in accordance with the general custom of the trade in Britain. The handling of feedingstuffs leads on the one hand to compounding, and on the other to the purchase first of feed grains and then of milling wheat and malting barley, with the development of the expertise necessary to these operations. Purchase involves storage, and also drying if the grain has been combined. Sales of seed lead to purchase from the farmer, cleaning, dressing and the handling of selected strains. Fertilizer sales lead to mixing and, in some cases, spreading. Sales of machinery require the maintenance of repair shops and the stocking of spare and repair parts. Entry into one branch of the engineering field may lead to others; for example, the installation of farm water supplies or undertaking members' cultivation on contract. All these enterprises are making their contribution to actual production on the farm, by putting reliable raw materials and machinery at the farmers' disposal, by providing a check on local prices of all goods which are not controlled, and by returning any surplus on the

undertaking to the farmer himself in the form of bonus on business done. (A single member may receive as much as £800 a year from this source, making an appreciable difference to farm income.)

Co-operative Marketing There are, however, activities which do not grow automatically from the requirements business, but which it has often been found convenient to graft on to an established multipurpose co-operative. These are principally forms of marketing, especially egg-packing stations, fruit and vegetable marketing, wool marketing and, in a few cases, livestock auctions. In recent years, installations like grass driers have been included. The advantages of such accretions is that an organization which has already stable finance, experienced management and a local reputation with farmers, can more safely embark on a new project than one which has all its capital to raise and in which members, committee and staffs are all equally green and equally unknown to one another. The disadvantage is that these specialized enterprises frequently interest only a part of the membership, or are by their nature accessible only to a limited number. This is especially true of grass driers. In such cases complaints may arise. If the service is successful, why should those who have never used it share in the profits? If it is a failure, why should they be burdened with the loss? Most societies, in considering such developments, weigh carefully their probable effects both on the co-operative as a business concern and on the general progress of farming in the society's area.

The specialized marketing societies are in a simpler position. The strongest group is that handling eggs. They owe their position in the first place to the pioneering work which they undertook, in collaboration with the Ministry of Agriculture, in the days of the National Mark and the first serious attempt to place a graded and tested British egg on the British market. They improved that position through the years and have played a leading part in the war-time and post-war organization of egg sales. Today they handle one-third of the packing station output.

The dairy co-operatives were not so well organized when the Milk Marketing Scheme first came into operation. With the exception of a few specialized co-operatives (mostly cheesemakers) the movement was superseded by the Board rather than integrated with it. The wool marketing co-operatives have, however, their niche in the Wool Marketing Scheme, though not one which fully satisfies their own sense of the possibilities of co-operative development.

Co-operative bacon factories, though not numerous, are solidly prosperous. With one or two brilliant examples, in operation for many years and available for imitation, it is something of a mystery why co-operative livestock auctions are not more numerous. The sales of dairy and store cattle, which pass directly from farmer to farmer, seem particularly suited for management by the principals themselves. The marketing of fruit and vegetables presents, as everyone knows, peculiar difficulties. The products are perishable, seasonal and much affected by weather. The same can almost be said of the market. Prices have remained largely unfixed, and foreign competition is a powerful factor. Grades and standards have been particularly difficult to apply and enforce. Some excellent work has been done by a number of growers' co-operatives; others have relied too much on foreign models and have found them difficult to apply in British conditions. There is obvious room for development and a readiness on the part of growers, but indiscriminate ventures are recognized as dangerous.

Scope for Development In its earliest years, British co-operation was sponsored by voluntary central organizations, the Agricultural Organization Societies of England, Wales and Scotland, with a measure of Government support, given through the Development Commission. The Welsh Agricultural Organization Society has had an unbroken and valuable career of forty years. The A.O.S., on the other hand, was wound up in 1924, and though a number of attempts were made to replace it in the intervening years, it was not until 1946 that the English agricultural co-operatives re-established their own central body, in the form of the Agricultural Co-operative Association, which is once again supported in its educational work by the Development Commission, while the cost of its considerable administrative services are met by the subscriptions of its member societies. Within the last few months the National Farmers' Union has also registered two organizations in the form of joint stock companies "for promoting and servicing agricultural and horticultural co-operation".

To anyone familiar with agricultural co-operation, it will be obvious first that the volume of business and members compares by no means unfavourably with that in other countries, and, secondly, that there are considerable gaps in its services. Of these, the most notable is credit. In almost every country, from the United States and Canada to the peasant countries of the East, the provision of short- and long-term credit to the farmer is one of the most important co-operative undertakings. In Great Britain it does not exist.

Co-operative education for many years meant mainly education of the member or potential member in the possibilities of co-operative action. This is still needed, especially in the case of the smallholder, who is sometimes less ready than the larger farmer to join a co-operative. But there is an increasing demand for the internal education of staffs and committees, not only in the principles of co-operation but in the needs of the agricultural industry which co-operation can serve. From the experience already gained comes the realization that, with many co-operatives employing upwards of 800 men apiece, and new developments constantly in progress, something like a co-operative staff training college may well become necessary. Only by some such means can methods be standardized at a high level and the whole movement infused with the common purpose necessary, if the advance of the last few years is to be consolidated and continued.

THE CATTLE OF BRITAIN

The following articles are the first in a new series devoted to British breeds of cattle which will be contributed throughout the current volume by the relevant Breed Societies. The articles will be published in alphabetical order of breed, irrespective of character—dairy, beef or dual-purpose.

1. ABERDEEN-ANGUS

THE Aberdeen-Angus breed originated from a fusion of local breeds of cattle, some polled and some horned and almost all black, in the north-east of Scotland in the area ranging from the Firth of Tay to the Moray Firth. There is evidence from sculptured stones in the area dating back to prehistoric times that there were polled cattle there at least 1,500 years ago, and in deeds and charters of the thirteenth century mention is made of polled (or humble) black cattle. It was not, however, until the beginning of the last century that the development of the breed as we now know it was seriously and extensively taken in hand. One family of Aberdeen-Angus cattle belonging to the Angus area can be traced with certainty as far back as 1750, but the records upon which the first Herd Book was based do not extend beyond 1820, although several of the pioneers in Angus and Aberdeenshire were at work improving the amalgam of local breeds before then.

Of the pioneers, the most outstanding was Hugh Watson of Keillor, near Coupar-Angus, a sporting gentleman-farmer, who built up what is regarded as the first Aberdeen-Angus herd from black cows belonging to his father, black heifers from Aberdeenshire purchased at a fair, and a bull named "Tarnty Jock" bred by a farmer south of the Dee. The work done by Watson and by several other landed proprietors and tenant farmers in Angus was carried on very much further by William McCombie of Tillyfour in Aberdeenshire, who started his farming life as a partner with his father, one of the most extensive cattle dealers in Scotland, and who gradually developed into the leading cattle feeder and breeder of his day. McCombie based his work upon cattle, both male and female, bred by the Angus pioneers, and cows selected from good Aberdeenshire commercial herds. Out of his work sprang many of the great families of the breed – Prides of Aberdeen, Jilts, Ruths, Queen Mothers, Vines, and through one of his famous bulls "Trojan" the largest family of all, the Ericas, which became famous in the herd of the third great figure in the breed's history, Sir George Macpherson-Grant of Ballindalloch Castle.

McCombie was a born salesman and showman. He realized that a beef breed must make its reputation by the production of beef. He studied the requirements of the London market before competing in the main English fatstock shows and, having ascertained what the butchers wanted, he proceeded to breed and feed cattle to meet their requirements. With them, he enjoyed a long series of successes at the great Birmingham and early Smithfield Fatstock Shows, culminating in the complete triumph in 1867 of his Aberdeen-Angus steer "Black Prince", which won every prize available to him at both these shows.

McCombie also went further afield to catch the attention of great cattlemen overseas. He exhibited for twenty years at every International Livestock Exposition in France, winning many prizes, and finally, in 1878, with a team of one bull and five heifers, no member of which was more than twenty-six months old, he won the trophy for the best group of breeding animals and a

similar trophy for the best group of beef animals. Over sixty breeds of cattle competed in this contest and the runner-up for the best breeding group was a team from the equally famous Ballindalloch herd of Sir George Macpherson-Grant.

Sir George, who died in 1907, refined the Aberdeen-Angus breed during nearly fifty years of active participation in practical genetics, and established its chief families on a sound foundation of quality and strength of constitution, giving, through the bulls he used, beauty of conformation and great weight of hindquarters, which are the outstanding visible characteristics of the breed.

Although it was the last of the three great beef breeds to find its way overseas, the Aberdeen-Angus today dominates the beef cattle of New Zealand and is the second largest breed in both the U.S.A. and the Argentine. In the United States the Aberdeen-Angus Association has more members than any other beef breed society, and registers over 160,000 calves every year, while Aberdeen-Angus cattle hold the world's records for price of both bulls and females. In the Argentine there are also more Aberdeen-Angus breeders than of any other beef breed, and 21,000 calves were registered last year, several thousands more than the nearest competitor. In other beef-raising countries, such as Canada, South Africa, and Australia, the breed is noteworthy for its success in fatstock shows, and indeed, over the whole world, 75 per cent of the leading prizes at such shows are carried off by Aberdeen-Angus cattle.

The principal characteristic of the breed as regards beef is that its flesh is beautifully marbled with veins of fat, while the fat itself between the hide and the meat is not in such large quantity as to be wasteful. It is early maturing and it imparts its beefing and early maturity qualities, as well as its polled condition and black skin, to its crosses. It is very hardy, both in hot climates and in cold, and is an excellent rustler, as befits a native of the most exacting climate in the British Isles.

Although show figures admittedly refer to animals specially prepared for exhibition, it may be pointed out that all animals that compete have presumably been prepared in a similar way, and the winners therefore may be accepted as converting cattle food into human food more efficiently than those that are less successful. Further, no breed can achieve the expansion of the Aberdeen-Angus both at home and abroad on records of fatstock alone. A breed must satisfy both the producer and the butcher, as well as the public, under practical economic conditions of production, and the progress of the Aberdeen-Angus breed in all the great cattle-raising countries of the world is proof that it has earned the respect of these three partners.

The following are some statistics given with the foregoing observations in mind:

Smithfield Fatstock Club Champions, 1891–1953

	On Hoof	On Hook
Aberdeen-Angus	27	18
Aberdeen-Angus cross	12	14
All other breeds	12	12

Chicago Livestock Exposition Champions, 1900–53

Aberdeen-Angus and crosses	29	47
All other breeds	19	1

Alexander Keith,
Secretary, Aberdeen-Angus Cattle Society

2. AYRSHIRES

Even dairy farmers in Britain who have changed over to Ayrshires from other breeds have not always been fully aware of the reasons underlying the world-wide advancement of the Ayrshire breed over the past seventy years. If that is the case in the "home of the breed," then it must at least be equally so in countries far removed from Scotland.

Unfortunately, the absence of authentic documentation before 1750, makes the origin and development of the Ayrshire breed rather conjectural. It is definitely known, however, that in the eighteenth century Ayrshires were referred to as the "Black Breed" of cattle. But in 1811, the Minutes of the Kilmarnock Farmers' Club described the breed as the "Cunningham", the colouring by that time being the now well-known brown and white. Cunningham is a district in the northern part of Ayrshire other districts being Kyle in the centre and Carrick in the south of the county. Both Kyle and Carrick, as well as another Ayrshire district, Dunlop, have given their names to the breed at different times.

It cannot be disputed that the Ayrshire breed originated in the south-west of Scotland, and, in particular, in the county of Ayr. The pioneer breeders were a thrifty class of Scottish farmers, many of whom were cheese-makers who depended upon their cattle for a living—and because of the soft curd and small butterfat globules in Ayrshire milk, the Ayrshire cow was an obvious choice.

Of medium size—mature cows weigh in the region of 1,000 lb., bulls 1,500 lb. upwards—the Ayrshire is a finely boned animal of deep body capacity, particularly in the chest, the middle and the udder. The chest is deep and wide and the body of medium length, with a good spring of rib. The udder is of ideal shape, strongly supported, carried well forward and high behind—thus helping to keep it clean and free from injury; the teats are of good texture and convenient to milk, either by machine or hand.

The main reasons underlying the world-wide popularity of the Ayrshire cow are her inherent worth as a dairy animal in general, and her pre-eminence as an economic producer of high quality milk—characters derived from the skilful, practical and highly selective breeding policies pursued by Ayrshire breeders in the south-west of Scotland during the past 200 years.

The high position to which the Ayrshire cow has climbed is due to four characteristics : first, her hardiness and constitution, which enable her to thrive in climatic conditions and on poor or marginal pastures unsuitable to other breeds ; second, her regularity in calving ; third, her natural resistance to disease ; and fourth, her ability to roam and forage. Two other important factors which have contributed to the wide advancement of the Ayrshire breed, are the pioneering steps taken by Ayrshire breeders in milk recording and in attestation. Indeed, the breed has so long been associated with attestation that the names "Ayrshire" and "Attestation" may now be regarded as synonymous.

As already stated, the average Ayrshire weighs 1,000 lb. It is therefore amazing that such an animal should be capable of giving 10,000 lb. of milk—many give quantities greatly in excess of that figure—at 4 per cent butterfat, and on top of that, calve regularly year after year throughout a long lifetime. *Many Ayrshires have produced more than a hundred times their own weight of milk.* Admittedly, outstanding cows among the heavy dairy breeds will give quantities equally as great, but what about the cost? Ayrshires weigh 1,000 lb., while the others may weigh 1,500 lb. and upwards—nearly

500 lb. extra of cow to grow, feed and maintain, for no extra return. Progressive farmers are already aware of this fact; to others, it is worth pondering.

Newcomers to the Ayrshire breed may establish their herds either by purchasing pedigree animals right from the outset or by acquiring commercial or non-pedigree cattle of pure Ayrshire type and using them as the foundation stock whereon to grade-up their herds to pedigree status, through Appendices "B" and "A" of the Society's Herd Book. It is significant that experience has shown that both classes of breeder are wholly alike in the respect that once they have built up the nucleus of a herd—as opposed to a mere collection of animals—they all consistently pursue a policy of rigorous culling. By such means do Ayrshire breeders ensure the quality of the Ayrshire cow and the prestige of the breed. But what of the animals culled under such a policy? *It is true*—and the Society always takes the greatest pains to stress the fact—*that the Ayrshire is essentially a single-purpose dairy animal.* Nevertheless, and arising from the existing national beef emergency, many Ayrshire breeders are not only finding a profitable sideline for themselves but are also making a valuable contribution to the nation's larder by fattening their culls—as a pure extra to their dairy herds, which they still maintain unimpaired.

The Ayrshire breed is controlled by the Ayrshire Cattle Herd Book Society at 1 Racecourse Road, Ayr. This Society has pioneered the field by offering a vastly improved service to its members in the shape of Pedigree Registration Certificates (issued automatically to members on the entry of animals) which embrace both blood and milking pedigrees back to the fourth generation. Another aspect of the Society's work is its Research Department, which administers the approved sires and dams schemes and also the 150,000 lb., 100,000 lb., 80,000 lb. and 50,000 lb. Production Clubs. This department issues annually a Research Bulletin giving full particulars of the production of animals admitted into each of the foregoing classes. It is significant to note that two of the Ayrshire cows recently admitted to the 150,000 lb. Club have so far in their lifetime produced over 200,000 lb. of milk—a very creditable achievement indeed. And by way of a concluding note, a happy reference may be made to the ten-year-old Ayrshire cow "Knockdon Daybreak" (H.B. No. 80833), which created a world record for any Dairy Show by winning the milking trials *against all breeds* at the Scottish Dairy Show in February this year, with 114.3 lb. milk over the three milkings. What greater proof could one want of a breed's production capacity?

John Graham,
Secretary, Ayrshire Cattle Herd Book Society

AGRICULTURAL STATISTICS ENGLAND AND WALES

June 1953, Agriculture Returns (Final)

CROPS AND GRASS

(thousand acres)

DESCRIPTION	1939	1952	1953
Wheat	1,683	1,963	2,143
Barley	910	2,076	2,025
Oats	1,358	1,676	1,664
Mixed corn	83	827	794
Rye, for threshing	(b)	53	65
Beans, for stock-feeding	133	121	140
Peas, for stock-feeding	37	30	39
Potatoes, first earlies	56	121	120
Potatoes, main crop and second earlies	398	561	552
Total potatoes	**454**	**682**	**672**
Turnips and swedes for stock-feeding	396(c)	306	304
Sugar beet (for sugar)	337	398	404
Fodder beet (all types of high dry matter content)	(b)	69	64
Mangolds	210	216	207
Rape	53	140	142
Cabbage, kale, savoys and kohl rabi, for stock-feeding	94	250	284
Vetches or tares	49	27	33
Mustard, for seed, fodder or ploughing in	48	42	38
Linseed	4	17	10
Flax, for fibre		15	16
Hops	19	22	22
Orchards with crops, fallow, or grass below the trees	236	265	261
Orchards with small fruit below the trees	18	13	12
Small fruit, not under orchard trees	29	32	31
Vegetables for human consumption (excluding potatoes), hardy nursery stock, flowers and crops under glass	275	435	452
Fruit and vegetables, not grown primarily for sale	(b)	10	14
All other crops	48	27	25
Bare fallow	355	298	217
Lucerne	32	106	109
Temporary grass (including clover and sainfoin):			
for mowing	1,304	2,309	2,209
for grazing	768	1,367	1,447
Total temporary grass	**2,072**	**3,676**	**3,655**
TOTAL ARABLE LAND	**8,935**	**13,792**	**13,840**
Permanent grass:			
for mowing	4,612	2,924	2,892
for grazing	11,097	7,776	7,662
Total permanent grass	**15,709**	**10,700**	**10,554**
Arable land and permanent grass temporarily out of use through flooding	—	—	118
TOTAL ACREAGE OF CROPS AND GRASS (a)	**24,643**	**24,492**	**24,511**
Rough grazings:			
sole right (excluding acreage temporarily out of use through flooding	4,179	3,890	3,806
" " (temporarily out of use through flooding)	—	—	18
common	1,361	1,479	1,479(d)
Total rough grazings	**5,541**	**5,369**	**5,303**

(a) Excludes rough grazings.
(b) Not separately returned.
(c) Includes turnips and swedes for human consumption.
(d) Provisional.

SMALL FRUIT (*thousand acres*)

DESCRIPTION	1939	1952	1953
Strawberries	18.7	16.0	16.5
Raspberries	4.1	4.3	3.8
Currants, black	10.4	15.0	13.0
Currants, red and white	2.3	1.4	1.2
Gooseberries	9.1	7.1	6.7
Loganberries and cultivated blackberries	2.5	1.2	1.2
Total small fruit	47.2	44.9	42.4

VEGETABLES FOR HUMAN CONSUMPTION, HARDY NURSERY STOCK, FLOWERS AND CROPS UNDER GLASS

(*thousand acres*)

DESCRIPTION	1939	1952	1953
Brussels sprouts	38.0	45.5	49.4
Remaining spring cabbage (planted in previous year)	44.1	8.9	8.5
Summer cabbage		7.7	9.4
Autumn cabbage		5.2	5.2
Winter cabbage		12.9	13.7
Autumn savoys		3.5	3.3
Winter savoys		9.4	9.2
Kale and sprouting broccoli		2.0	1.8
Winter cauliflower or broccoli (heading):	18.9	21.7	
remaining from 1952 plantings			2.2
planted in 1953			8.7
Summer and autumn cauliflower:			
Early summer, sown under glass and planted in the open			3.9
Late summer and autumn (open sown)			8.3
Carrots, earlies (grown for bunching only)	16.1	27.3	2.4
Carrots, main crop			28.8
Parsnips	(a)	3.4	3.7
Turnips and swedes	(a)	5.6	4.2
Beetroot	(a)	8.9	8.2
Onions, grown for salad	1.7	1.3	1.4
Onions, for harvesting dry		4.1	5.1
Beans, broad	17.8	5.1	5.1
Beans, runner		8.1	7.5
Beans, dwarf or french			1.6
Peas, green for market	60.6	39.1	46.5
Peas, green for canning or quick freezing	28.0	26.3	32.3
Peas, for harvesting dry		122.6	118.6
Asparagus	2.6	1.7	1.5
Celery	6.7	4.1	4.5
Lettuce	5.9	6.5	7.3
Rhubarb	7.2	7.8	6.1
Tomatoes (growing in the open)	0.2	1.7	1.5
Other vegetables and mixed areas	(a)	15.2	14.0
Total vegetables for human consumption (excluding potatoes) grown in the open	247.7	405.7	424.3
Hardy nursery stock	10.5	10.7	10.4
Bulbs grown for flowers:			
Daffodils (Narcissi)			2.0
Tulips			1.2
Other bulb flowers			0.8
Bulbs grown for sale as bulbs:	7.7	6.7	
Daffodils (Narcissi)			0.8
Tulips			0.9
Other bulbs			0.2
Other flowers, not under glass	5.8	7.2	7.1
Total bulbs and flowers in the open	13.5	13.9	13.0
All crops grown under glass	3.3	4.6	3.9

(a) Not returned.

The figures for 1953 given above are based on returns which account for almost 100 per cent of the total area returned under this heading.

LIVESTOCK

(thousands)

DESCRIPTION		1939	1952	1953
Cows and heifers in milk:				
for producing milk or calves for the dairy herd		2,255	2,103	2,140
mainly for producing calves for beef			268	303
Cows in calf but not in milk:				
intended for producing milk or calves for the dairy herd		392	388	378
intended mainly for producing calves for beef			76	85
Heifers in calf with first calf		459	696	645
Bulls for service		91	82	77
Bulls (incl. bull calves) being reared for service		43	31	31
Other cattle:				
two years old and over	Male (steers)	(a)	553	548
	Female	(a)	665	653
	Total	**944**	**1,218**	**1,200**
one year old and under two	Male (steers)	(a)	424	445
	Female	(a)	957	966
	Total	**1,346**	**1,381**	**1,411**
under one year old	Male (steers)	(a)	441	506
(excluding bull calves	Female	(a)	1,042	1,086
being reared for service)	**Total**	**1,242**	**1,483**	**1,592**
TOTAL CATTLE AND CALVES		**6,770**	**7,727**	**7,861**
Sheep one year old and over:				
Ewes for breeding		7,160	5,081	5,261
Two-tooth (shearling) ewes		1,477	1,203	1,287
Rams for service		205	140	145
Other sheep one year old and over		1,021	1,334	1,366
Total one year old and over		**9,863**	**7,758**	**8,060**
Sheep under one year old:				
Ram lambs for service		156	65	65
Other sheep and lambs		7,967	5,764	5,969
Total under one year old		**8,123**	**5,829**	**6,034**
TOTAL SHEEP AND LAMBS		**17,986**	**13,586**	**14,094**
Sows in pig		(a)	232	262
Gilts in pig		(a)	90	134
Other sows for breeding		(a)	145	156
Total sows for breeding		**449**	**467**	**553**
Barren sows for fattening		(a)	20	15
Boars for service		30	27	30
Young boars being reared for service		(a)	10(9.7)	11(11.3)
All other pigs:				
Five months old and over		633	1,005	820
Two to five months old		1,516	1,437	1,524
Under two months old		888	875	983
Total all other pigs		**3,036**	**3,316**	**3,327**
TOTAL PIGS		**3,515**	**3,840**	**3,936**
Fowls:				
Six months old and over		23,154	27,804	27,950
Under six months old		29,758	37,256	36,214
Total fowls		**52,912**	**65,060**	**64,164**
Ducks		2,237	1,903	1,768
Geese		584	635	637
Turkeys		693	944	1,057
TOTAL POULTRY		**56,426(b)**	**68,543**	**67,626**

(a) Not separately returned.
(b) As a result of war-time controls, many small-sized holdings were recorded for the first time in 1941. It is estimated that to make the totals prior to 1941 reasonably comparable with later years some 3 or 4 million birds should be added in England and Wales.

LIVESTOCK (*thousands*) contd.

DESCRIPTION	1939	1952	1953
Horses used for agricultural purposes:			
Mares (including those kept for breeding) ..	347	125	109
Geldings	202	85	72
Unbroken horses of one year old and over:			
Light .. .. }	110	{ 13	13
Heavy .. .. }		{ 6	6
Horses under one year old:			
Light	15	5	5
Heavy	35	3	3
Stallions being used for service:			
Light .. .. }	5(4.6)	{ 1(0.8)	1(0.8)
Heavy .. .. }		{ –(0.4)	–(0.4)
All other horses (not entered above)	132	78	74
TOTAL HORSES	**846**	**316**	**282**

LABOUR

(*thousands*)

DESCRIPTION	1939	1952(b)	1953(b)
Regular workers:			
Male 65 years old and over .. .. }	375.3	{ 24.7	23.4
„ 21 years old and under 65 .. .. .. }		{ 382.0	376.5
„ 18 years old and under 21	44.7	38.6	32.8
„ under 18 years old	50.8	42.7	42.0
Total male	**470.8**	**488.1**	**474.7**
Women and girls	40.3	45.6	45.6
Total male and female	**511.1**	**533.7**	**520.3**
Casual workers:			
Male, 21 years old and over	57.4	95.6	93.8
„ under 21 years old	5.9	10.6	10.4
Total male	**63.3**	**106.2**	**104.2**
Women and girls	32.7	62.0	58.6
Total male and female	**96.0**	**168.2**	**162.8**
Total male workers	**534.1**	**594.2**	**579.0**
Total female workers	**73.0**	**107.7**	**104.2**
TOTAL WORKERS	**607.1**	**701.9**	**683.1**

(b) Revised and more comprehensive instructions on the labour section of the form, introduced for the first time in September 1948, resulted in the return of additional workers. The figures for June 1952 and June 1953 are not, therefore, comparable with those for 1939.

FARMING AFFAIRS

Progeny Testing Progeny testing was the theme of the major part of the eighteenth meeting of the British Society of Animal Production held in Edinburgh last year. The full text of the papers read at the meeting, which covered the work in progress and value of progeny testing in cattle, pigs, poultry and hill sheep, has just been published by the Society,* but the following short summary of the practical application of progeny testing and its likely value to the improvement of cattle and pigs may be of interest.

DR. ALAN ROBERTSON pointed out that progeny testing is of greatest value when three conditions are fulfilled: (a) the heritability of a character is low and the performance of the animal is of little indication of its breeding value; (b) the character cannot be measured in one sex or can be measured only after slaughter; and (c) the size of the breeding unit is high. Recent work in Edinburgh, based on material on the progeny testing of bulls published by the Milk Marketing Board, showed that 80–90 per cent of the variation in yield between progeny groups has nothing to do with the breeding value of the sire but is due to chance and the level of management under which the daughters are milked. The practical solution, he suggested, might be to compare the performance of the daughters of one bull with the daughters of another milked under the same conditions and during the same period. Dr. Robertson was also critical of the fact that in the past A.I. centres have played no constructive part in cattle breeding in this country, but have merely been intermediaries in the passage of genes from the fashionable pedigree herds into the commercial herds.

The methods being adopted by the Milk Marketing Board in the progeny testing of dairy bulls used for A.I. were explained by MR. D. B. BROWN. The use of progeny-recorded sires in A.I., although ideal, had been impossible in the past, because such bulls were not obtainable in the required number from the breeders. A survey in 1951 showed that three-quarters of the bulls used in recorded herds in England and Wales bred less than ten recorded daughters. Of the remaining quarter, where there was a reasonable amount of evidence of their daughters' yields, no less than two-thirds of the sires were dead by the time the records were available, so that only about 8 per cent remained to form the progeny-recorded group. This group was further seriously depleted by bulls failing to achieve the standards required for conformation, health and semen production.

Under the present M.M.B. scheme, teams of three to five young bulls are used intensively for a period of between three and five months in selected "bull-proving" herds. Each young bull is used for about 150 effective inseminations, which should produce 20–25 daughters completing a first lactation. One-half of the cows in the "bull-proving" herds are inseminated from the bulls under test; the remainder are inseminated from older bulls—the majority of which are progeny tested—and these provide the contemporary daughters against which the daughters of the young bulls will be tested. In addition to production records, the progeny are inspected for conformation, udder quality and other general utility points. After completing the test period, the young bulls are dispersed, but those that prove satisfactory are returned to the area when about six years old for a period of intensive use.

* *Proceedings of the British Society of Animal Production*, 1953. Obtainable from the Secretary of the Society, Institute of Animal Genetics, King's Buildings, West Mains Road, Edinburgh 9, price 12s. 6d.

The advent of frozen semen will mean that nominated service to individual bulls will be practicable and this will permit more constructive policies to be adopted. Before bulls are used for "mass production", it is considered advisable to try them in a number of sire-daughter matings as a safety measure against spreading possible lethal or undesirable genes.

Dealing with pig progeny testing in Denmark, MR. G. R. H. BISHOP corrected a popular misconception that the Danes record as well as test their pigs. No recording of weights of piglets occurs at any time, either at or before weaning, and this accounts for the fact that the weight of the Landrace piglet at weaning does not appear heavy by British standards. It is on prolificacy and rearability—not on weaning weight—that the Danes have concentrated.

The early days of testing in Denmark—from 1907 until after the First World War—are least valuable in attempting to assess the part played by testing in breed improvement, since environmental conditions were constantly being improved during this period. Undoubtedly the best time for assessing the value of progeny testing occurred in Denmark between 1927 and 1939, when conditions were standard. During this period improvement took place in every respect, with the exception of ham size and quality, which remained constant. The most substantial improvement was in body length, which was accompanied by a corresponding reduction in the thickness of backfat. There was also an increase of 1 per cent in the amount of bacon for sale—and this, despite the fact that the longer pig is known to produce a lower percentage of bacon for sale than the shorter pig. Selective breeding also brought about increased firmness of backfat.

Another point of interest in the Danish bacon industry is the progeny-testing reports, which are compiled by the research laboratory for the guidance of the owners of breeding centres. These reports are published frequently and give in summarized form the results of all litter groups sired by all the boars tested, thus enabling breeders to make immediate and important decisions about the future of any breeding stock.

Although all sows on breeding centres have to contribute a litter group for testing at least every two years, Danish progeny testing is, for all practical purposes, boar testing. But the success of Danish methods depends on more than technique. "It depends," said Mr. Bishop, "on something much more fundamental—clarity of purpose, simplicity of approach, and on an ability to co-operate. For the Danes this meant concentration on bacon only. It meant working with few breeds—the two that were originally considered to be most promising. It also meant an intrusion upon the independence of the individual breeder in the interest of them all. Without these things, pig progeny testing could not have succeeded in Denmark."

W. Longrigg

Farming Cameo: 40. Bromyard and Ledbury, Herefordshire

The Malvern Hills form a natural boundary between Herefordshire and Worcestershire, and from the ridge of these hills it is possible to see the whole of the Bromyard and Ledbury district lying to the west and north. Unsullied by the smoke of industry and the encroachment of urban development, it is a truly rural scene of uneven broken country, well wooded with oak and elm and overlaid with a patchwork pattern of arable and grass fields, hop yards and orchards.

Geologically, the area is mainly Old Red Sandstone, which gives rise to a useful red loam soil varying in depth from a few inches to many feet and in texture from medium to heavy. There is a fringe of Silurian Limestone following the line of the Malverns in the east and Marcle Hill and the Woolhope Dome in the south. The grey soils deriving from the Silurian are also variable, but generally they are rather heavier and more difficult to work than the red loam. In all, the district comprises about 95,000 acres split up into 1,300 holdings, of which about 500 are under 20 acres and very few more than 250 acres in size. The fields are generally small—as might be expected in an area of many small farms and steep slopes. Apart from the holdings of a few specialist fruit-growers, most farms carry about one-third in tillage and a mixed stocking of cattle and sheep, plus a few pigs and poultry. Broadly speaking, hops and fattening cattle are to be found on the lower land and store cattle on the higher ground, with dairy cattle and sheep evenly distributed.

Not unexpectedly, the white-faced Hereford and its crosses account for the majority of the 30,000 cattle in the district. Most of the cattle are sold as one- or two-year-old stores and find ready buyers from all parts of the country, but some are finished on the rich pastures of the Frome Valley. There are several famous pedigree Hereford herds in the area, and the well-boned animals produced speak well not only for the breeders but also for the quality of the land. Although beef cattle predominate, the dairy breeds are well represented and dairying is important, particularly on the smaller farms. Few farms are without sheep, and with a sheep population of nearly 70,000 is obvious that they play an important part in the farm economy. Most farmers keep a breeding flock but some buy in tegs for fattening on roots or to act as scavengers. A black-faced ewe of the Clun type is very popular; Shropshires, Kerrys, Welsh and Border Leicesters are also found, but the native Ryeland is represented by only one pure-bred flock.

Most farm crops can be, and indeed are, grown; oats, mixed corn, beans, roots and green crops are produced for winter stock-feeding, making self-sufficiency no idle dream. Wheat is the main cash crop with about 8,000 acres; barley, sugar beet and potatoes are grown on a more limited scale. Hop yards are a feature of the landscape, accounting for some 3,000 acres, so that the district can claim the biggest concentration of hops outside Kent.

A cider mill is still to be found on most farms, but very few of the mills are used nowadays, the apples being sent to the cider factory. Although a few specialist fruit-growers have highly productive and well-managed orchards containing good varieties, many farm orchards are more than fifty years old and contain useless varieties. However, most farmers are now taking advantage of the grants available to grub these orchards and to bring the land into full agricultural production.

With a rainfall of about 30 inches well distributed throughout the year conditions are favourable to grass. The general standard of farming is very good, but there is still room for increased production from grassland. The response to lime and phosphate, particularly basic slag, is fully appreciated, but more potash and nitrogen could be used to good effect on many farms.

This has always been a noted stock district, and as a result of the increased use of leys and more intensive grassland management, together with the growth of attestation, the trend is towards more and better stock.

J. Pendlebury,
District Advisory Officer

The Mechanic on the Farm: 1. Repairing Tractor Tyres Many machinery repairs are best left to the implement agent, but there are some which can be done just as well by a farmer or farm worker, and again there are those that are too urgent to await the arrival of the implement agent at the farm, even though we know he would make a more workmanlike job of them. Mending punctures in tractor tyres is fortunately not a frequent job, but it is usually an urgent one, and when the tyre is flat the tractor cannot be run to the agent to be repaired on his premises. Tyre repairing is therefore one of the things a farm mechanic should be prepared to tackle.

The removal of rear tractor tyres is not as strenuous a task as might be thought from their large size. The rims on the wheels of most tractors are of the well-base type, and removing and replacing the tyres is easy once the knack of using the well to advantage has been acquired. The tyres are, however, of the wired-on type, and it is almost impossible to get them off if the wrong technique is used. The wire in the bead cannot be stretched and is slightly shorter than the circumference of the rim at the edges. Any attempt to lever the bead directly over the edge of the rim is thus doomed to failure. But since the circumference of the rim at the middle of its width is much smaller than the circumference at the edge, the bead of the tyre can be pushed right down into the well of the rim when the tyre is deflated. If then the bead is kept pressed into the well at any one point of the tyre, it will become loose on the rim on the circumference on the opposite side of the tyre, and at that point it can be slipped over the edge of the rim.

The most reliable way of repairing the tube is to vulcanize it. Small vulcanizers, in which a pellet of solid fuel is used to provide the heat, can be bought quite cheaply and they are simple to use. If no vulcanizer is available, rubber solution and patching must be resorted to. The surface of the tube should be roughened with a wire brush and the rubber solution must be allowed to dry beyond the tacky stage before the patch is put into position. Two coats of solution are better than one, but the first coat must be allowed to dry completely before the second one is applied.

When the tyre is being replaced, the beads should again be put down into the well on one side of the wheel before any attempt is made to lever the tyre over the edge of the rim. Care must be taken to see that the tube is not pinched between the bead and the rim, and when the tyre is first inflated it should be to a pressure of about 30 lb. per square inch, so that the beads are forced into their correct position in the rim. Some of the air can then be let out until the gauge shows the pressure recommended by the tyre-maker for the conditions in which the tractor is to work.

H. J. Hine

Colorado Beetle in 1953 In March and April 1952 there was a disturbing increase in the numbers of Colorado beetles that arrived in this country with lettuce imported from those parts of southern Europe which were infested with the beetle. Consequently, in 1953 an Order was made prohibiting the importation of lettuce from such regions after the end of February—that is, one month earlier than in previous years. This resulted in a marked decrease in the numbers of beetles arriving in this country with lettuce in the early months of 1953. During March and April only three beetles were discovered in imported produce, as compared with fifty-two in the same period in 1952, a decrease that is almost entirely ac-

counted for by the reduction in numbers of beetles on imported lettuce. The following table summarizes the year's discoveries: figures for the two previous years are given for comparison.

	1953	1952	1951
Beetles associated with or on imported produce ..	38	64	41
Beetles found on ships	12	19	17
Docksides and beaches	8	1	5
Inland on potatoes	0	0	0
Inland miscellaneous	8	27	8
Odd dead beetles	3	0	10
On aircraft	0	1	2
	69	**112**	**83**
No. of breeding colonies	0	2	8

The first beetle reported in 1953 was found on January 19 in a lettuce from Spain. This was followed by three beetles in February—two from Spain and one probably from France—again in lettuce. During March and April only three beetles were found, as mentioned above. Twenty beetles were found in May and June, of which five were on imported produce and five on docksides after ships from the Continent had unloaded their cargoes. In spite of detailed inquiries, the origin of the remainder could not be traced. At the height of summer beetles fly readily and they do not always remain on the produce with which they are imported. In July eleven beetles were reported; six of these were on ships carrying cargoes from France, Belgium and Spain.

Of the twenty-seven beetles found in August and September, twenty-one were in a refrigerated railway wagon from Tarragona, Spain. The wagon contained 1,123 boxes of peaches and arrived at Ferry Dock, Dover on August 1. During the Customs inspection four beetles were found and reported, and after a preliminary inspection the wagon was allowed to go on to Paddock Wood station, where it was unloaded under careful supervision. It was at this stage that most of the beetles were discovered. Later, the contents of the boxes were examined. Two live beetles were found among the fruit and one crushed beetle was in the covering paper. Eight of the twenty-one beetles were alive. Finally, during December four beetles were found, two in lettuce from the Perpignan district of France, one in Italian lettuce and the fourth in a tin of apricot pulp from Spain. It is believed that the abnormally mild weather experienced in southern Europe in December may have induced beetles to remain active above ground later than they normally would have done. At the time, a press notice was issued asking the public to keep a special watch for beetles in lettuce imported from the south of Europe.

Three beetles were reported in Scotland. The first—a dead one—was found in a container of preserved peaches on May 4. On July 17 one live beetle was found in Glasgow docks shortly after a cargo of onions from Valencia had been unloaded. The third beetle was discovered in the hold of a ship at Boness Docks.

No colonies of beetles or larvae were found in any part of the country at any time during the year.

The total acreage treated under the 1953 protective spraying campaign was considerably less than in recent years. Areas were reduced where it was considered that the danger was not as great as in the past. In addition,

it was not thought necessary to start the campaign especially early to deal with those early potatoes which were likely to be lifted before the spraying of maincrops began.

In marked contrast to the previous year, the weather in 1953 was most unfavourable for all the protective spraying work. The persistent wet conditions resulted in rapid growth of potato haulm, and this made work very difficult for the spraying teams. Because of the danger of excessive damage to haulms, and since the weather was so unfavourable, the spraying was stopped on July 30, although some 600 acres still remained of the area which it was originally intended to spray. The total acreage sprayed by ground machines was 14,101, comprising 2,251 fields classified as follows:

Acres	No. of Fields	Percentage of Total
Under 2	409	19
2-5.9	903	40
6-10	582	25
Over 10	357	16

The DDT spray used was a 25 per cent miscible liquid and was applied at the rate of 1 lb. technical DDT per acre. On 56 acres of potatoes in Surrey a DDT dust was applied with an experimental machine. The Romney Marsh region was sprayed by helicopter during the first fortnight of July, when 2,300 acres were treated with DDT emulsion.

It is a pleasure once again to thank all concerned with the campaign and with the reporting of actual and suspected beetles. Particular thanks are due to the staff of Plant Protection Ltd., who were responsible for organizing the protective spraying work, and to Pest Control Ltd. for the helicopter spraying.

I. Thomas

Changes in Canadian Agriculture It is customary to think of changes in the Canadian way of life in terms of vast mineral developments, new oil and gas discoveries, and huge electrical power installations. But no less remarkable, if less spectacular, changes have occurred in Canada's oldest industry—agriculture.

According to the 1951 census, there were two-and-a-half times as many trucks and tractors, and five times as many grain combines on farms as in 1941. The number of farms supplied with electricity increased from 117,000 to 336,000 between 1944 and 1951, while electricity consumption per farm customer increased by about 65 per cent. Other interesting comparisons show that although total occupied farmland increased by about 0.3 per cent between 1941 and 1951, the number of farms dropped from 733,000 to 623,000 in the same period. Today, the average size of farm is 279 acres.

The amount of fertilizer used increased from 170,000 tons in 1927 to 769,000 tons in 1952. New pesticides and artificial insemination have been added to agricultural production methods in the past decade. Purchases of feed and seed, expressed as a proportion of total farm expenses, increased from 10.3 to 22.1 per cent between 1926 and 1950 in Canada as a whole; in Quebec the change was from 16.1 to 46.2 per cent.

The one downward trend, probably in consequence of some of the other increases, was in farm population. Although the Canadian population increased to 14 million in 1951 from 11.5 million in 1941, the number of people on farms dropped from 3.1 million to 2.8 million in the same period. In other words, the farm population dropped from 27.1 to 20.2 per cent of the total population.

Report on Animal Health Services, 1952 For the principal animal diseases, 1952 was a year of fluctuating fortunes. There were sharp increases in the numbers of outbreaks of foot-and-mouth disease and anthrax, substantial falls in those of fowl pest and swine fever, and a virtual elimination of sheep scab. May was the peak month for foot-and-mouth disease with 187 fresh cases. Thereafter, there was a decline in new outbreaks and the year ended with a clean sheet. With anthrax, however, there was a sustained increase in new outbreaks throughout the year, culminating in a peak of 209 in November. Fowl pest, after being relatively quiescent all the year, broke out again in December, when 268 new cases were confirmed. This proved to be the opening phase of a long and difficult period. Over the whole year, foot-and-mouth disease and fowl pest necessitated the slaughter of over 75,500 animals and more than 322,000 fowls respectively, and cost the country some £2¾ million in compensation.

More detailed information on the outbreaks of livestock diseases is given in the recently published *Report on Animal Health Services in Great Britain*, 1952*, together with an account of the progress that has been made towards the eradication of bovine tuberculosis, and a description of the measures taken to prevent the introduction and spread of diseases from abroad. Sections of the report are also devoted to the measures for the protection of animals in transit, the research work being carried out at the Ministry's Veterinary Laboratories and by the Veterinary Investigation Service, and to progress in artifical insemination.

The Agricultural History Review Although a Lectureship in the History and Economics of Agriculture was endowed at Cambridge nearly sixty years ago (the Gilbey Lectureship), it is only recently that more general recognition has been given to the contribution that history can make to the better understanding of the farmer's craft. However, a big step forward was taken last year with the founding, under the Presidency of Sir James Scott Watson, of the Agricultural History Society, with the idea of bringing together the growing number of those who are attracted to the study of the social and economic history of British agriculture and rural life. The initial fruits of this new association of historians have now appeared in the form of the first issue of the Society's journal *The Agricultural History Review*†. Unfortunately, it is impossible, here, to do more than notice very briefly some of the contents.

Sir James Scott Watson writes pleasantly of many traditional farming beliefs, upon which he plays the searchlight of modern science, while doing well to remind us that the accumulated experience of two hundred generations of practical men must not lightly be dismissed without investigation. How many times has it proved that farming practice is long years ahead of the scientific justification for it? M. W. Beresford, Lecturer in Economic History at Leeds, records a long forgotten attempt by Parliament, in 1549, to impose a poll tax on sheep and a purchase tax on cloth, both abandoned within twelve months. One of the objects of the sheep tax, he suggests, was to check the further expansion of the Tudor enclosures and to bring grassland

* Published by H.M. Stationery Office, price 3s. (3s. 2d. by post).

†The Review is available only to members of the Society. The annual membership subscription is one guinea.

once more under the plough. Another contributor, Joan Thirsk, Senior Research Fellow in Agrarian History at Leicester, who writes of the Isle of Axholme, the only part of Lincolnshire (some 50,000 acres) on the western side of the Trent, before Vermuyden attempted to improve its drainage. The Isle is still remote, still cultivated largely in the strip formation of the old open fields, and Dr. Thirsk's point—that the great Dutch engineer accomplished not so much a better system of husbandry as a different one—is well maintained.

For the rest, W. E. Minchinton, Research Lecturer in Social and Economic History at Swansea, gives an account of early attempts by the State to collect agricultural statistics during the Napoleonic Wars; and John Rowe, Lecturer in Modern History at Liverpool, has resuscitated a letter written in 1872 by a Cornish farmer who had migrated to Ontario some thirty years before, in which he contrasts methods and opportunities in Canada and the home country. A list of recent publications, compiled by G. E. Fussell and others, and some reviews of books contributed by well-known historians, completes a valuable first number.

The Editor of the new journal is H. P. R. Finberg, Reader in English Local History at Leicester, and he and his contributors have set a high standard for it. Mr. Finberg is further to be congratulated on the clear printing and general format of the volume.

C. S. Orwin

BOOK REVIEWS

Plant Diseases (2nd Edition). F. T. Brooks. Oxford University Press. 38s.

The first edition of this book was published in 1928, when a new standard text was urgently needed. Although long out of date, it has remained in constant use as an invaluable source of reference, for no other book produced since contains so much factual information condensed in such a convenient manner. By undertaking the great task of preparing a second edition, Professor Brooks has again earned the gratitude of plant pathologists, and it is distressing that he did not live long enough to see the fruits of his labours and to receive their thanks. However, the new edition stands as a suitable memorial, fittingly reflecting his great energy, meticulous attention to detail, and his personal interests.

Although appropriate enough in 1928, the title now hardly indicates the book's contents. True, there are chapters on non-infectious diseases and virus diseases, but they total less than 50 pages, and can do no more than introduce these large subjects. The bulk of the book is concerned with fungus diseases, to which the whole might with advantage have been restricted, for the other 50 pages could then have been more usefully employed in discussing the general principles that underlie disease outbreaks and their control. As it is, the book is a mine of information on fungi and the diseases they cause, but it contains little that could be guaranteed to persuade students that plant pathology can be an exciting and fascinating study. In effect, it is an encyclopaedia of fungus diseases, with diseases catalogued according to the taxonomic position of the causative fungus. It will be, and will long remain, an essential working book, the *vade-mecum* for all those who have to diagnose fungus diseases or who need summaries of knowledge on specific diseases.

The value of such a reference book depends greatly on the index, and it is pleasant to report that consulting *Plant Diseases* is made very easy by the exceptionally detailed indexing.

F.C.B.

Poultry Breeding. A. L. HAGEDOORN and GEOFFREY SYKES. Crosby Lockwood. 18s.

In the introduction to the first part of this book, Dr. Hagedoorn states that it was not written either for geneticists or students of that science, but as much of the material is of the substance and style of a text-book of genetics, it is only fair to point out to the general reader that recent developments and modern theoretical conceptions in this important subject are either inadequately dealt with, or not referred to at all.

Apart from the two sections of the book being contained within one cover, there seems to have been little collaboration between the authors—a practising geneticist and a progressive poultry-breeder—except in their respective roles as initiator and active disciple of the "Nucleus Breeding System," to which many references are made.

Systems of breeding animals are not rare, but where they spring from theoretical considerations they require adequate evidence of reliability in field practice before their intrinsic worth is generally realized. The actual field data given in the second part of the book refer to two generations of selection only, and it seems a pity that more recent progress has not been included.

The authors wander far and wide in their respective fields and express their opinions forcefully. As a record of experience, it is an interesting and provocative book which will have an appeal for some and little for others engaged in keeping poultry both for pleasure and profit.

A.W.G.

Back Crossing. MARY THOMAS. Commonwealth Agricultural Bureaux. 15s.

In this new addition to the C.A.B. series of publications, Mrs. Thomas sets out to review the literature concerned with back-crossing in relation to four important agricultural crop plants—cotton, tobacco, tomato and potato. This is no mean task, since plant breeders have been concentrating increasingly in recent years on the introduction, by means of back-cross methods, of valuable characters found mainly in wild species. Altogether, no less than 436 references are listed and reviewed, giving a clear picture of the extent to which back-crossing was used by plant breeders prior to 1950.

It is not surprising that most of the literature cited deals with breeding for disease resistance. In these days of expanding agriculture and intensive crop cultivation, problems of disease control loom larger every year. The plant breeder's purpose is to introduce disease-resistant qualities wherever possible, whether it be to counteract Blackarm in cotton, Mosaic in tobacco, Leaf Mould in tomato or Blight in potato.

In this country the interest in cotton and tobacco breeding must be largely academic, although these crops have been the subject of much important research elsewhere. The section dealing with tomato breeding, most of which emanates from American investigations, gives a clear indication of the many problems being tackled and of the potential value of several wild species, such as *L. pimpinellifolium*, in breeding for disease resistance. The part devoted to potato breeding, which incidentally is the smallest section, is concerned mainly with resistance to blight, frost, and to the Colorado beetle. It refers to the breeding possibilities of about a dozen different species and indicates that *S. demissum*, *S. acaule* and *S. chacoense* are the species most successfully used in breeding for resistance to blight, frost and the Colorado beetle respectively.

Written in a straightforward style and with an excellent index, this book brings together in convenient form a great deal of information which was previously scattered throughout a large number of scientific journals. The subject-matter, being necessarily specialized and technical, is unlikely to have a wide appeal among practical agriculturists, but it is particularly useful to specialists in plant breeding and can be recommended strongly to students interested in breeding and genetics.

W.B.

Social Provision in Rural Wiltshire. H. E. BRACEY. Methuen. 21s.

The typical English village no longer exists. It is doubtful if it has ever existed except in our imaginations, although it would have been much easier to connect the image with the reality if we had been able to jump on H. G. Wells's time machine and travel about the countryside between the years 500 and 1500 A.D. Then, although the village had variation in form and size, it had a definite service function in relation to a measurable area of rural countryside. In the nineteenth and twentieth centuries, however, English villages have,

like English towns, English industries and English agriculture, been pulled one way or the other by an ever-increasing complexity of social and economic forces. Thus we may dip into this book expecting to find in such a seemingly placid county as Wilsthire a relatively simple pattern of rural life. The one we find, however, is confused and full of variation. Dr. Bracey has been painstaking in unravelling the picture for this one county. The commercial and professional services, social organizations, public utility services and local administrative areas are given in detail, and their service areas are shown. The author has then worked out a system of grading which shows the strength of each Wiltshire town and major village as a provider of facilities to local people.

This book thus has value and purpose to the casual traveller in Wiltshire, as well as to those concerned with improving living conditions therein. Also, to the more serious student of English modern rural life, it is an example of a new approach with new methods and techniques of analysis. Similar types of analyses will be needed for many other counties before it is possible to generalize on the basic variations of twentieth century English rural life, or on where some of these patterns are leading us.

G.P.W.

British Grasslands from the Earliest Times to the Present Day. T. BEDFORD FRANKLIN. Faber. 21s.

This book is unique and welcome, for it is the first to be devoted solely to the history of British grasslands. And in terms of time it does the job thoroughly, starting with the evidence of the prehistoric pollen from the peatlands and ending with the modern pastures on which so much of our economic future now depends. The Neolithic clearances, the Domesday meadows, the Tudor sheep-runs, the enclosed grazings of the eighteenth and nineteenth centuries, all are passed in brief but balanced review, their origins and functions sketched, their ecology, as well as their economics, explained, and the story reaches modern times via Clifton Park, Cockle Park and Aberystwyth. The making of the green field is one of the epics of our race, and into the achievement which we have inherited has gone the labour and the thought, the individual genius and the communal effort of many, many generations.

It is, indeed, a fine story that Mr. Franklin tells in this pleasantly-produced and well-written book, and the manner of its telling owes much to the author's special qualifications. He comes of farming stock, with nine generations of Midland graziers, as well as three agricultural books of his own, behind him, and one of his best chapters traces the development of a certain meadow on his grandfather's farm from its geological origins to its contemporary restoration after use as a bombing-range. In the years to come, this fascinating microcosm of rural history may well take a deserved place among the classic passages of English rural history.

So fine a local study could not have been written without genuine personal enthusiasm. But such enthusiasm has the defects of its merits, and in this case it has certainly outrun Mr. Franklin's sense of history. For instance, his statement that " in 410 the Romans withdrew from Britain " merely repeats crude school-book history known to be obsolete a generation ago and shows clearly that he has not consulted such standard authorities on the Saxon Settlement as Collingwood or Hodgkin. Neither does he give any clear account of the changing role of grass in the agricultural system which developed after the collapse of the High Farming in the 1870s. The omission from his bibliography of Price's 1949 thesis, which deals largely with this subject, is perhaps excusable, but the omission of Haggard's work, which is the best authority for one stage of this rural revolution, is not. Nor does he attempt to fix in the reader's mind the "landmarks" of pastoral history. No mention is made of Eustace of Islip, the first Englishman known by name to have sown grass seed, and it is not made clear that Stillingfleet was the first Englishman to put on readily available record the agricultural properties of the common grasses. Similarly, the last of the great Welsh " upland summerings " took place in 1862. Yet no reference is made to this end of an ancient tradition. And, incidentally, with what evidence or definition of " ley farming " does Mr. Franklin substantiate his startling claim that the monks of Coupar in 1400 " practised the system of ley farming as used today " ?

This book contains much valuable and interesting information which has never before been collected between two covers, and despite its defects, it should be read by all interested in grassland matters or in farming history. But accurate information arranged in chronological order is no more than the beginning of historical wisdom, and unfortunately it cannot be said that Mr. Franklin has done for the British grasses what Darby has done for the Fenlands, Orwin for Exmoor, and Salaman for the potato.

N.H.

Legumes in Agriculture. F.A.O. Study No. 21. R. O. WHYTE, G. NILSSON-LEISSNER and H. C. TRUMBLE. 15s.

Although the authors state that this new F.A.O. publication is not intended to be a text-book, it is in fact a mine of information on legumes in world agriculture. One of the objectives has been to present a picture of the problems connected with leguminous crops which are engaging the attention of research workers in many countries at the present time. More than a hundred eminent authorities, representing different fields of scientific investigation and widely contrasting territories, have contributed to Part I.

Against a background of fundamentals and valuable reference tables, the reader will be especially struck by the main theme, which seems to be the immense contributions to production which have already been made by legumes in some countries (as by wild white clover in Britain and by subterranean clover in certain other parts of the world), and by the urgent need in other countries, especially in the tropics and sub-tropics, to search for and introduce into farming practice other legumes which would contribute just as handsomely under those vastly different conditions.

The problems are, of course, not confined to the types of legume with which most of us are familiar, but include quick-growing types capable of making the best use of a short season and of competing with "giant" companion plants, as well as leguminous shrubs, to provide scanty browsing in unfavoured areas. Chapter 7 summarizes information collected for F.A.O. by questionnaire about the use of legumes, their limitations and possibilities in various tropical and sub-tropical countries, and is published here for the first time.

Part II of the volume contains notes on some sixty-seven genera, a bibliography for further reference, and an appendix briefly setting out the characteristics of various species. There are something like seventy illustrations.

W.Q.C.

Long Ashton Research Station Annual Report, 1952. 15s.

Long Ashton has been associated for many years with investigations on the part played by the so-called "minor", or "trace", elements in plant nutrition. Until recently, the emphasis of these studies has been mainly on fruit nutrition, but the minor elements profoundly affect many farm crops as well as orchard crops, and it is therefore of interest to note that this work has now been established on a more permanent basis by the setting up at Long Ashton of a separate Agricultural Research Council Unit of Plant Nutrition (Micro-Nutrients). The work of the Unit, which includes investigations on a number of agricultural crops, is reviewed in a special section of the report.

The practical grower will be particularly interested in a set of research papers that describe work on spray application problems. An automatic low-volume sprayer, which under trial applied tar oil winter wash and lime sulphur-DDT mixtures to black currant bushes as effectively as by hand lance, but at a third of the cost, is described.

A number of practical pointers arise from other spraying trials conducted at the Station. In using air flow application of spray materials against red spider mite, for example, it has been found necessary to have sufficient air volume and velocity to lift the leaves so that their lower surfaces are exposed to the action of the spray.

Other papers deal with the pollination requirements of cider apple varieties; comparisons of the yield and quality of dessert apples under different systems of planting, spacing and shaping; cover crops in relation to cider apple nutrition; and a new method of nursery procedure in the management of plum trees so as to avoid winter pruning and the accompanying risk of losses from bacterial canker.

The report includes a valuable author and subject index covering the forty-six years from 1907, when the report was first issued as a separate publication.

A.J.L.L.

The Use of Aircraft in Agriculture in the U.S.A. Organisation for European Economic Co-operation.

A great deal of interest has been shown in recent years in the adaptation of the aeroplane to agricultural uses, and for that reason alone this new O.E.E.C. booklet should be assured of a wide audience. It is, in fact, the report of Technical Assistance Mission No. 107 to the U.S.A., which was composed of experts on agricultural aviation from Austria, Denmark, France, Germany, Italy and the Netherlands.

The report points out that in the U.S.A. at the moment, nearly 7,000 aircraft are used for agricultural purposes, such as spraying (insecticides and weedicides), dusting, fertilizer

application, defoliation, seeding, aerial photography, forestry fire patrol, meteorology, soil survey, brush clearance and educational air tours by farmers. In Western Europe only 65 aircraft are at present used for such purposes, and the Mission therefore suggests that there is a very wide scope for expansion and a consequent substantial increase in agricultural production. Such expansion, however, would call for encouragement by Governments.

Apart from general considerations of the usefulness of aircraft in agriculture, the booklet gives valuable information on field operations, equipment, spray rates and materials, and economic data. It is interesting to note that the average American price last year for fertilizer spreading was 10s. per acre, compared with 10s. 6d. per acre in the United Kingdom.

Great Britain was not a member of the Mission, nor does the booklet make any reference to the pioneer work carried out in this country in respect of the aerial application of fertilizers, but aerial spraying by means of fixed wing aircraft and helicopters is routine in many parts of the country, and there is undoubtedly much in this report which is capable of application here.

The booklet is obtainable from H.M. Stationery Office, P.O. Box 569, London, S.E.1, price 6s. (6s. 3d. by post).

A.W.L.

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Vermuyden and the Fens. L. E. HARRIS. Cleaver-Hume. 21s.

The drainage of the fens is one of the most spectacular episodes in our agricultural history and it has produced a substantial literature. But this is the first complete biography of Sir Cornelius Vermuyden, who was the main executant of "those profitable works, the Commonwealth's glory," and Mr. Harris has brought to it his professional understanding as an engineer as well as a wealth of information from prolonged research in England and Holland.

Vermuyden, Mr. Harris tells us, came of Zeeland stock and began his professional career in England in the 1620s, first on the Erith floodings and the Dagenham Breach, then on the more ambitious Hatfield Chase scheme. Finally, in 1630, he was appointed engineer of the Fenland scheme, and from then till 1655 he was continuously, if irregularly, associated with the project to which he owes his lasting fame. The general story is, of course, familiar from other books, but Mr. Harris both demolishes legend and brings much new material into print. He emphasizes, for instance, that Vermuyden never proposed to drain the whole Fenland; he was concerned only with the Bedford level, some 300,000 acres of the total 700,000 acres of the "Great Drownings". More original is the evidence he produces of the general migration of Dutch engineers to this country at that time. Holland, it seems, was exporting the unique skill of her drainers, even as in the nineteenth century England exported the unique skill of her railwaymen.

It is clear, however, that Englishmen needed little urging to invest their money in reclamation schemes. Indeed, there was bitter competition and bitter intrigue in high places to gain the prospectively profitable right of financing the Fenland project. Mr. Harris does his valiant best to read between the contemporary lines, but it is doubtful if the full story of the Adventurers will ever be recovered. It was a crudely commercial age, vast sums of money were involved and the formal documents faithfully say little about the reasons (and nothing about the reasons behind the reasons) for the various decisions they record. The financial ground floor where Vermuyden and his company-promoting colleagues so astutely installed themselves still keeps many of its secrets.

As the biography of a technician who was also a businessman, this book has its weaknesses. In particular, it gives little information on the practical execution of the drainage works, on the number of men and kind of tools employed, for instance, or the personal responsibilities of Vermuyden. Neither are we told much about his technical and commercial colleagues, though their collective historical importance is very considerable. Incidentally, one would like to know a lot more about that enchantingly improbable drainage-promoter, the Ruritanian "Philibert Vernatti, Knight of San Marco," whose hair went white during an imprisonment from which he was released by the intercession of the Duke of Orsuna's mistress). And it is unfortunate that the publication of this book should coincide with that of Dr. Joan Thirsk's *Fenland Farming in the Sixteenth Century* which, by challenging the traditional picture of the undrained Fenlands as an abomination of agricultural desolation, raises questions which it could not be expected to foresee or answer. Nevertheless, Mr. Harris has added much to our knowledge of the life and work of Vermuyden, and his book should be read by all interested in the agricultural and economic history of his age.

N.H.

Principles of Agricultural Engineering. WM. C. WILSON. Green. 15s.

The title of this book is misleading, since the author does not intend it to be regarded as a text-book on the principles of agricultural engineering. In the preface, Mr. Wilson states that his purpose is "to present the necessary fundamentals in an easily understood form, presupposing no knowledge of mathematics other than a little elementary arithmetic", and further, that "Formulae are stated and explained but not derived". Within these limits the subject is covered. Briefly, it comprises the formulae commonly used in simple engineering calculations, with some worked examples utilizing these formulae and a number of groups of problems, many of which are based on farm machinery, for the student to solve.

The final examinations for the National Diploma in Agricultural Engineering call for a more practical approach to engineering problems and a rather higher standard of mathematics than are found here. The student of agriculture, who is preparing himself for his diploma, will, however, find the book useful in familiarizing himself with the type of calculations called for.

F.C.

The Drying and Storage of Combine Harvested Grain (Monographs on Malt and Malt Products). Muntons Ltd., Bedford, and Edward Fison Ltd., Ipswich. Free.

This little 36-page booklet deals in turn with the use of combine harvesters, the physical and biological properties of live grain, the moisture relationship between air and grain in bulk, causes of deterioration of grain, principles of grain drying, and practical methods of grain storage and handling. The treatment of the subject is general rather than detailed, and the booklet is valuable chiefly for the interesting way in which a considerable amount of what may be called the scientific background to grain drying and storage is presented. On the more practical side, one or two of the statements made are open to argument. For example, not all would agree that " the private ownership of a combine is usually only economical on farms growing over 200 acres of cereals," or, in connection with the bulk handling of grain, that " at least two lorries are needed for each combine".

The subject of drying grain with warm air in ventilated bins is briefly discussed, but only low rates of air flow through the grain (for example, 12 feet per minute) are considered. Modern designs usually provide for rather higher air speeds.

Despite these minor defects, almost everyone who is interested in any aspect of grain drying and storage will find something of interest and value in the booklet.

C.C.

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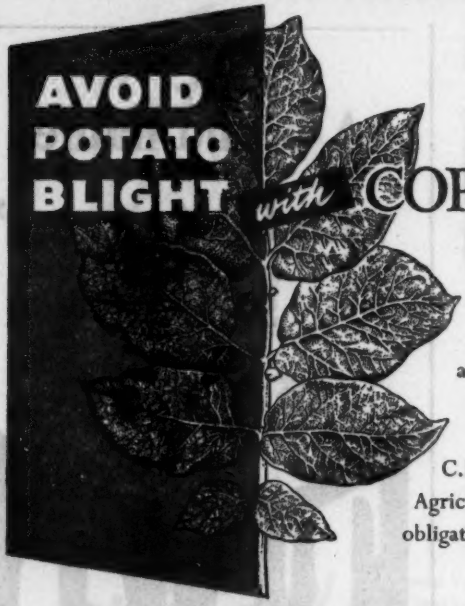

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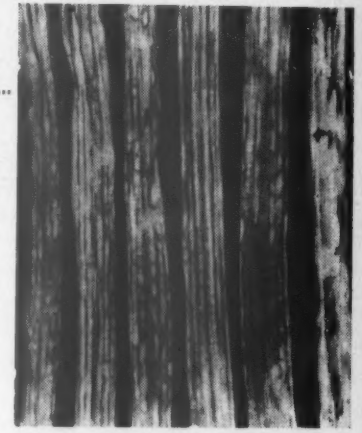

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